# SPIE. PHOTOMASK TECHNOLOGY + EUV LITHOGRAPHY

1–5 OCTOBER 2023 | MONTEREY CONFERENCE CENTER
MONTEREY, CALIFORNIA, USA

# SPIE. PHOTOMASK TECHNOLOGY + EUV LITHOGRAPHY

The premier technical meeting for photomasks, patterning, metrology, materials, inspection/repair, mask business, extreme ultraviolet lithography, and emerging technologies.

**Conferences: 1–5 October 2023**
**Exhibition: 3–4 October 2023**
Monterey Conference Center
Monterey, California, USA

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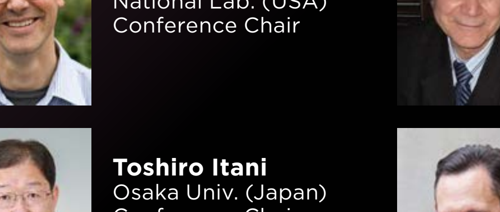
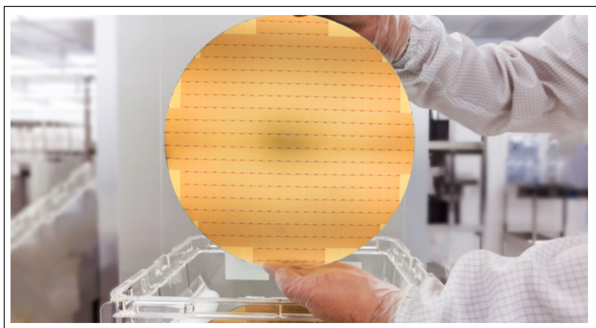


**Toshiro Itani**
Osaka Univ. (Japan)
Conference Chair

**Kurt G. Ronse**
imec (Belgium)
Conference Chair

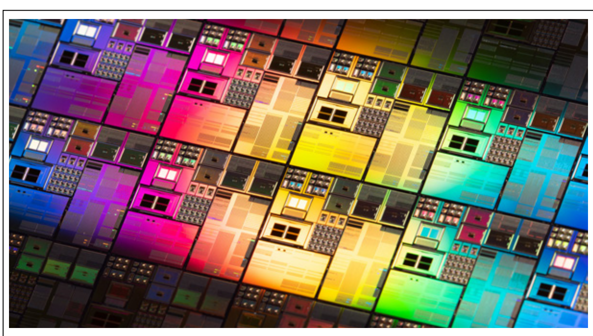
# Experience the energy of SPIE Photomask Technology + EUV Lithography

Get ready to enjoy engaging conversations, hear the latest breakthroughs, and make important connections in person. Hear cutting-edge research on photomasks, patterning, metrology, materials, inspection/repair, mask business, extreme ultraviolet lithography, emerging technologies, and more. Attend technical presentations, the free exhibition, plenary presentations, and a variety of networking activities.



**PHOTOMASK TECHNOLOGY**—PAGES 8–18

Addressing key topics related to photomasks.



**EXTREME ULTRAVIOLET LITHOGRAPHY**—PAGES 8–18

Addressing the worldwide status of EUV technology and infrastructure readiness.

**Plenary Sessions**—PAGES 4–5

Presentations by leading speakers sharing their latest developments, industry insights, and visions for the future.

**Networking and Technical Events**—PAGE 6

Poster sessions, panel discussion, and networking with a technical focus.

**EXHIBITION**—PAGES 20–23

The free exhibition will run 3–4 October 2023. The premier exhibition for mask makers, EUVL, emerging technologies, and mask business. Connect with top suppliers showcasing the newest products, innovations, and latest technologies.

Facility Map—PAGE 2

General Information—PAGE 3

SPIE Policies—PAGE 26

**SPIE. DIGITAL LIBRARY**

INCLUDED WITH REGISTRATION

**50 proceedings downloads**

Paid registration includes 50 content downloads from the SPIE Digital Library. SPIE will email details on using proceedings downloads.

See full details and updates at spie.org/puv or on the SPIE App

# MONTEREY CONFERENCE CENTER

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LEVEL TEN
SAN CARLOS BALLROOM
I II III IV
LOS ANGELES
SANTA BARBARA
SAN DIEGO
SAN FRANCISCO
SANTA MONICA
Hotel Front Entrance (FIRST FLOOR)
MEZZANINE
SKY BRIDGE
STEINBECK BALLROOM
III
II
I
COLTON
Escalator from Street Level
LEVEL TWO
Registration
CALLE PRINCIPAL
DEL MONTE AVE

# GENERAL INFORMATION

## Badge pick up and registration hours

**Monterey Conference Center**

**Steinbeck Lobby**

| | |
|---|---|
| Sunday 1 October | 3:00 PM–6:00 PM |
| Monday 2 October | 7:30 AM–4:00 PM |
| Tuesday 3 October | 7:30 AM–4:00 PM |
| Wednesday 4 October | 8:00 AM–4:00 PM |
| Thursday 5 October* | 8:00 AM–11:00 AM |

*Thursday is conference registration only

## SPIE Cashier

**Monterey Conference Center, Steinbeck Lobby**

### Registration payments

If you are planning to register onsite, your credit card payment will be processed during registration. If you wish to pay with cash or check, register at the "Need to Register" station; you will be directed to the Cashier once you have completed registration except for final payment. If you have already registered and wish to add a special event, you may do so at the "Need to Register" station.

### Receipt and Certificate of Attendance

Preregistered attendees who need an SPIE-stamped receipt or attendees who need a Certificate of Attendance may obtain those at the SPIE Cashier.

### Badge Corrections

Badge corrections can be made at the Cashier.

## Speaker check-in

All presenters are requested to go to their conference room at least two hours prior to session start with their USB memory device to load their presentation and check display settings.

SPIE will record the audio plus screen content of all presentations.

## Poster set up

**Monterey Marriott, San Carlos III/IV**

Poster session details:

| Monday 2 October 2023 | 6:00 PM - 7:30 PM |
|---|---|

Poster setup is between 2:00 PM - 6:00 PM. Poster authors, visit Poster Presentation Guidelines for set-up instructions.

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## Business Center

**Monterey Marriott**

Attendees may use their Monterey Marriott hotel room key to access the onsite Business Center, which offers use of the free online computers and printers. Copy and fax machines are available at the front desk.

## SPIE Conference App information

Search and browse the program, special events, participants, exhibitors, and more. Build your personalized schedule and sync with the online MySchedule tool. Free Conference App available for iPhone and Android phones. Information about restaurants and food options also available on the App.

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## Internet Access

At the Monterey Conference Center, SPIE provides complimentary wireless access on Level 2. Level 2 wireless internet includes the Steinbeck and Colton meeting rooms, the Exhibition area and the Steinbeck lobby.

**Network: SPIE Free WiFi**

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## Childcare services

### Art on Wheels Creative Childcare and Events

**831-402-9192**
**Nicole Rappa Macauley**
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**www.artonwheelsmontereykids.com**

Note: SPIE does not imply an endorsement or recommendation of these services. They are provided on an "information only" basis for your further analysis and decision. Other services may be available.

## Quiet Room and Mothers' Lounge

**Monterey Marriott, Salon 109**

See SPIE registration desk for access.

The quiet room and mothers' lounge is a lockable room intended for nursing mothers, silent meditation, reflection, or prayer. There is no storage, running water, or refrigeration available in this space.

## Urgent message line

An urgent message line is available during registration hours: 360-685-5529

## Lost and found

Found items will be kept at the SPIE Cashier during registration hours each day and then turned over at the end of the day to the Monterey Conference Center (831-646-3770) or the Monterey Marriott (831-649-4234) depending on the location where they were found.

## Food and beverage services

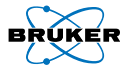
Complimentary coffee will be available during registration hours from Monday through Thursday at the Monterey Conference Center.

### Complimentary Breakfast Breads

| Monday–Thursday | Monterey Conference Center, Steinbeck Lobby | 7:30AM – 8:30 AM |
|---|---|---|

### Coffee Breaks

| Day | Location | Time |
|---|---|---|
| Monday 2 October | Monterey Conference Center, Steinbeck Lobby | 7:30 AM – 4:00 PM |
| Tuesday 3 October | Monterey Conference Center, Steinbeck Lobby | 7:30 AM – 9:30 AM |
| | Monterey Conference Center, Steinbeck 1 | 10:00 AM – 4:00 PM |
| Wednesday 4 October | Monterey Conference Center, Steinbeck Lobby | 7:30 AM – 9:00 AM |
| | Monterey Conference Center, Steinbeck 1 | 9:30 AM – 4:00 PM |
| Thursday 5 October | Monterey Conference Center, Steinbeck Lobby | 7:30 AM – 11:00 AM |

SPONSORED BY: 

### SPIE hosted lunches

**Monterey Marriott, San Carlos Ballroom**

**12:00–1:15 PM**

All paid conference attendee registration includes complimentary lunch Monday through Wednesday.

### Monterey Restaurants

See a list of area restaurants, with hours
https://www.seemonterey.com/food-wine/restaurants

## Car rental

**Hertz Car Rental**

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Contact Hertz: 1-800-654-2240

# PLENARY SESSIONS

Hear from world-class speakers on the industry's challenges and breakthroughs.

Open to all paid conference attendees.

## Monday All-Symposium Plenary

**2 October 2023 • 8:20 AM - 10:00 AM | Monterey Conf. Ctr., Steinbeck 2/3**

Join us for engaging plenary lectures from leaders in the field sharing their research and vision of the future

8:20 AM to 8:40 AM

### Announcements and Welcome

8:40 AM to 9:20 AM

### Breakthrough at the National Ignition Facility and retrospective on transformational collaborations between the inertial fusion and EUV lithography communities

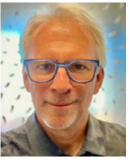
**Vincent Tang**
Lawrence Livermore National Laboratory (United States)

On December 5th, 2022, the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL) performed the first experiment demonstrating controlled fusion ignition in the laboratory. With 2.05MJ of UV laser drive energy delivered to the target, a fusion yield of 3.15MJ was achieved, providing a net target gain of 1.5x. The results of this experiment will be discussed, along with the decades-long developments in optical materials, laser architectures, target fabrication, and target diagnostics enabling this historical accomplishment. This talk will review the ignition breakthrough as well as the historical context and collaboration between our communities for EUV lithography. We will also discuss the next steps for NIF and provide an outlook on future applications and opportunities for continued partnership between our communities to develop transformational technologies, including technologies needed for the reinvigorated pursuit of Inertial Fusion Energy (IFE) and for next generation laser driven light sources for semiconductor fabrication.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

9:20 AM - 10:00 AM

### Combining optical and nanoimprint lithography: 2D photomask imaging to produce 3D nanostructures



**Bernard Kress**
Google (United States)

Optical lithography through photomask imaging has been the workhorse for 2D wafer scale nanostructure production sustaining Moore's law since more than 5 decades. NanoImprint lithography (or soft lithography) has been a great technique to produce arbitrary 3D wafer scale nanostructures since more than 2 decades. Optical lithography is generally limited to 2D nanostructures (gray scale lithography only providing some relief) and nanoimprint lithography is limited by small aspect ratio and relatively conventional nanostructure geometries as well as by the number of replicas a single hard master can provide. Merging the best of both worlds as in non contact 2D optical imaging to produce arbitrary 3D nanostructures could allow industry to move around such limitations. We will review the latest efforts done towards these goals and some potential developments for the next years.

## Wednesday All-Symposium Plenary

**4 October 2023 • 8:20 AM - 9:40 AM | Monterey Conf. Ctr., Steinbeck 2/3**

8:20 AM to 9:00 AM:

### Shaping the future: The power of advanced OPC and mask technology

**Linda K. Somerville**
Micron Technology, Inc.
(United States)

The semiconductor industry is constantly evolving, and advanced OPC and mask technologies are at the forefront of this evolution. In this keynote address, we will explore the power of these technologies and their role in shaping the future of the industry. Photomask technology and quality significantly influence how well semiconductor chip design objectives are realized in the final product. From enabling higher resolution lithography to improving yield and reducing costs, advanced OPC and mask technology have the potential to revolutionize the semiconductor industry. Through practical examples, we will demonstrate the impact of these technologies and provide insights into the future of semiconductor manufacturing. Join us as we explore how advanced OPC and mask technology are shaping the future of the industry.

9:00 AM to 9:40 AM:

### Directions, challenges and opportunities in heterogeneous integration

**Ravi Mahajan**
Intel Corp. (United States)

Heterogeneous Integration (HI) is a powerful and crucial enabler for the continued growth of computing and communication performance. Advanced packaging technologies are critical enablers of HI because of their importance as compact, power efficient platforms. This talk will focus on the tremendous opportunities in different application environments and focus on the projected evolution of advanced packaging architectures. Interest in HI research has picked up in recent years and this opens up greater collaboration opportunities between academia and industry. Specific examples, showing how product implementations take advantage of currently available HI technologies, to provide an unprecedented level of performance, will be used to describe the challenges and opportunities in developing robust, next generation advanced package architectures. A broad scope roadmap of the future generated as part of an industry-academic collaboration will be discussed in this context to highlight the opportunities generated by HI. Opportunities in physical interconnect scaling, an important part of the HI Roadmap will be discussed in detail with a focus on processes to create fine pitch, high performance interconnects.

**SPIE. ADVANCED LITHOGRAPHY+ PATTERNING**

**Present your work at the conference for solving challenges in optical and EUV lithography, patterning technologies, metrology, and process integration for semiconductor manufacturing and adjacent applications**

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# NETWORKING AND TECHNICAL EVENTS

Connect and explore important topics in depth at technical events designed to provide focused discussions and learning.

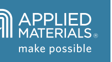
Open to all paid conference attendees.

## Poster Session

**2 October 2023 • 6:00 PM - 7:30 PM**
**Monterey Marriott, San Carlos IV**

Symposium attendees are invited to attend the Poster Session on Monday evening. This session provides an opportunity for attendees to meet with colleagues, network, view posters and interact with the authors. Attendees are requested to wear their conference registration badges.

Poster setup is between 2:00 PM and 6:00 PM.

SPONSORED BY: 

## All-Symposium Panel: How low can k1 go in EUV lithography?

**4 October 2023 • 4:00 PM - 5:45 PM**
**Monterey Conf. Ctr., Steinbeck 2/3**

Join us for an exciting panel discussion on the k1 factor in EUV lithography!

MODERATORS:
**Patrick Naulleau,** The Ctr. for X-Ray Optics (United States)
**Seong-Sue Kim,** Seoul National Univ. (Republic of Korea)

PANELISTS:
**Anton DeVilliers,** TEL (Japan)
**Chan Hwang,** Samsung (Republic of Korea)
**Claire van Lare,** ASML (Netherlands)
**Kurt Ronse,** IMEC (Belgium)
**Marie Krysak,** Intel Corporation (United States)

In this year's all-symposium panel discussion, we would like to aim to delve into the fascinating world of EUV lithography. As we all know, the industry has made tremendous strides in implementing EUV lithography for IC chip HVM since the second half of 2019. However, despite these remarkable advancements, we must acknowledge the significant gap that remains in the k1 factor, the process capability index of resolving power, compared to ArF-immersion technology.

Given this current reality, our focus for this year's discussion centers around the theme: "How low can k1 go in EUV lithography?" In traditional optical lithography, the k1 factor is primarily influenced by the process window, as well as the local CD uniformity. However, in the case of EUV lithography, we face an additional challenge—stochastic defects emerge as significant factors impacting the k1 factor. Understanding and addressing the behavior of stochastic defects, which exponentially increase as CD decreases, pose substantial hurdles that require extra effort.

# NETWORKING EVENTS

These sessions give you the opportunity to network, learn, and discuss with like-minded professionals from around the world.

## Student-Mentor Luncheon

**2 October 2023 • 12:15 PM - 1:30 PM**
**Monterey Conf. Ctr., Colton Room**

All students attending the conference are invited to join industry experts at lunch.

## Dessert in Exhibition Hall

**Monterey Conf. Ctr., Steinbeck 1**

**Tuesday 3 October 2023 .................... 1:15 PM - 1:45 PM**

**Wednesday 4 October 2023 ................ 1:00 PM - 1:20 PM**

Enjoy dessert in the Exhibition Hall while networking with exhibitors.

## Women in Optics Networking Lunch

**4 October 2023 • 12:00 PM - 1:00 PM**
**Monterey Conf. Ctr., Colton Room**

Join other women in the field for informal discussions and networking.

## Gala at the Barns

**4 October 2023 • 6:00 PM - 9:00 PM**
**The Barns at Cooper Molera**

All paid attendees and exhibitor representatives are welcome to participate in this gala dinner hosted at the historic Barns at Cooper Molera.

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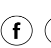

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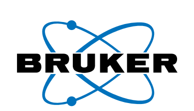

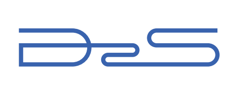

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**consists of unwanted, unwelcomed, and uninvited behavior that demeans, threatens, or offends another.**

To report harassment you have witnessed or experienced at this meeting, contact any SPIE staff member or use the SPIE reporting hotline at 1-888-818-6898 or spie.ethicspoint.com.

*More information:*

**spie.org/conduct**

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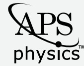

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# TECHNICAL CONFERENCE SCHEDULE

<table>
<tr><th>TIME</th><th>CONFERENCE 12750<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 3<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12750<br>International Conference on Extreme Ultraviolet Lithography 2023</th><th>CONFERENCE 12751<br>LOCATION: MONTEREY CONF. CTR., STEINBECK 2<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12751<br>Photomask Technology 2023</th></tr>
<tr><td colspan="3">MONDAY 2 OCTOBER</td></tr>
<tr><td>8:20 AM - 10:00AM<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 2/3</td><td colspan="2">Welcome and Monday Plenary Session<br>Session Chairs: Ted Liang, Intel Corp. (USA); Patrick P. Naulleau, The Ctr. for X-Ray Optics (USA)<br>Announcements and Welcome<br>Breakthrough at the National Ignition Facility and retrospective on transformational collaborations between the inertial fusion and EUV lithography communities (Plenary Presentation), Vincent Tang, Lawrence Livermore National Lab. (USA)<br>Combining optical and nanoimprint lithography: 2D photomask imaging to produce 3D nanostructures (Plenary Presentation), Bernard C. Kress, Google (USA)</td></tr>
<tr><td>STEINBECK LOBBY</td><td colspan="2">Coffee Break • 10:00 AM - 10:30 AM</td></tr>
<tr><td rowspan="8">MORNING<br>10:30 AM - 12:10 PM</td><td colspan="2">SESSION 1 • JOINT SESSION WITH PHOTOMASK TECHNOLOGY AND EUV CONFERENCES<br>High-NA EUVL<br>Session Chairs: Ted Liang, Intel Corp. (USA); Jan van Schoot, ASML Netherlands B.V. (Netherlands)</td></tr>
<tr><td colspan="2">12751-1 • Invited Paper<br>Actinic pattern mask inspection for high-NA EUV lithography, Toshiyuki Todoroki, Kou Gondaira, Lasertec Corp. (Japan); Arosha Goonesekera, Lasertec USA Inc. (USA); Hiroki Miyai, Lasertec Corp. (Japan)</td></tr>
<tr><td colspan="2">12750-1 • Invited Paper<br>High-NA EUV platform realization as next step in EUV technology, Jara . Garcia-Santaclara, Rudy Peeters, Jeroen van Dongen, Rob van Ballegoij, Sjoerd Lok, Jan van Schoot, ASML Netherlands B.V. (Netherlands); Paul Gräupner, Peter Kuerz, Carl Zeiss SMT GmbH (Germany); Joerg Mallmann, Greet Stoorms, Peter Vanoppen, ASML Netherlands B.V. (Netherlands)</td></tr>
<tr><td colspan="2">12751-2 • Mask registration for high-NA EUV lithography, Roman Schmeissner, Susanne Toepfer, Mikhail Poretskiy, Sven Martin, Stephan Zschaeck, Martin Steinhardt, Carl Zeiss SMT GmbH (Germany); Vivek Mishra, Cindy Zheng, Kowtilya Bijjula, Malahat Tavassoli, Intel Corp. (USA)</td></tr>
<tr><td colspan="2">12750-2 • Stitching for high-NA: zooming in, Natalia V. Davydova, ASML Netherlands B.V. (Netherlands); Lieve van Look, Vincent I. Wiaux, imec (Belgium); Laura Huddleston, ASML Netherlands B.V. (Netherlands); Ataklti I. Weldeslassie, Nick I. Pellens, imec (Belgium); Frank Timmermans, Daniel Wilson, Eelco van Setten, Bram Slachter, ASML Netherlands B.V. (Netherlands)</td></tr>
<tr><td colspan="2">12750-3 • High-NA EUV feature stitching: The impact of registration, flare and pitch dependent feature walking on stochastic failure rates, Stewart A. Robertson, KLA Texas (USA); Alessandro Vaglio Pret, KLA Italy Srl (Italy); Vincent I. Wiaux, imec (Belgium); Robert Schramm, KLA Texas (USA)</td></tr>
<tr><td colspan="2">12750-4 • Enabling the next step for on-product performance with high-NA EUV system, Kaustuve Bhattacharyya, Diederik de Bruin, Rudy Peeters, Jara G. Santaclara, Herman Heijmerikx, Rob van Ballegoij, Eelco van Setten, Jan van Schoot, Sjoerd Lok, Greet Storms, ASML Netherlands B.V. (Netherlands)</td></tr>
<tr><td colspan="2">Lunch Break • 12:10 PM - 1:40 PM</td></tr>
<tr><td rowspan="4">AFTERNOON<br>1:40 PM - 3:20 PM</td><td>SESSION 2 • 1:40 PM - 3:20 PM<br>EUV Process Technology<br>Session Chairs: Patrick P. Naulleau, The Ctr. for X-Ray Optics (USA); Geert Vandenberghe, imec (Belgium)</td><td>SESSION 2 • 1:40 PM - 3:20 PM<br>Mask Inspection and Repair<br>Session Chairs: Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan), Arosha W. Goonesekera, Lasertec USA Inc. (USA)</td></tr>
<tr><td>12750-5 • INVITED PAPER<br>Litho process development for pillars to enable high density 4f2 memory cells at 34nm pitch, Murat Pak, imec (Belgium); Arnaud Dauendorffer, Kathleen Nafus, Tokyo Electron Kyushu Ltd. (Belgium); Arijit Das, Mahmudul Hasan, Paulina A. Rincon-Delgadillo, imec (Belgium)</td><td>12751-3 • INVITED PAPER<br>Actinic inspection technology enhancement for n3 node and beyond, Hao-Ming Chang, Hsin-Fu Tseng, Chien-Hsing Lu, Sheng-Chang Hsu, Wei-Chung Hu, Ajay Nandoriya, Yi-An Huang, Yung-Sheng Chang, Chih-Wei Wen, Frankie F. G. Tsai, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Hiroki Miyai, Masayasu Nishizawa, Atsushi Tajima, Hirokazu Seki, Lasertec Corp. (Japan)</td></tr>
<tr><td>12750-6 • INVITED PAPER<br>LS printing validation of dark field low-n mask, Tatiana Kovalevich, Lieve Van Look, Joern-Holger Franke, Alain Moussa, Vicky Philipsen, imec (Belgium)</td><td>12751-4 • INVITED PAPER<br>Photomask contamination standards for defect inspection and review applications, William D. Dick, MSP Corp. (USA)</td></tr>
<tr><td>12750-7 • Single exposure EUV process optimization for SNLP and BLP layer for next-generation DRAM manufacturing, Andreia Santos, SCREEN SPE Germany GmbH (Belgium); Jeonghoon Lee, imec (Belgium); Elke Caron, SCREEN SPE Germany GmbH (Belgium); Syamashree Roy, Jelle Vandereyken, imec (Belgium); Masahiko Harumoto, SCREEN Semiconductor Solutions Co., Ltd. (Japan); Sandip Halder, Victor Blanco Carballo, Van Tuong Pham, Bappaditya Dey, imec (Belgium)</td><td>12751-5 • A new 193nm inspection tool for N3 EUV mask inspection, Yian Huang, Owen Wang, Rick Lai, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)</td></tr>
</table>

See full details and updates at **spie.org/PUV** or on the **SPIE App**

| TIME | CONFERENCE 12750<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 3<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12750<br>**International Conference on Extreme Ultraviolet Lithography 2023** | CONFERENCE 12751<br>LOCATION: MONTEREY CONF. CTR., STEINBECK 2<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12751<br>**Photomask Technology 2023** |
|---|---|---|
| AFTERNOON<br>1:40 PM - 3:20 PM | 12750-8 • **Validation of imaging benefits of dual monopole exposures,** Timothy A. Brunner, ASML (USA); Joern-Holger Franke, Vincent Truffert, Peter De Bisschop, imec (Belgium); Gijsbert Rispens, ASML Netherlands B.V. (Netherlands); David Rio, ASML (Belgium); Edouard Duriau, ASML Netherlands B.V. (Netherlands); Andre van Dijk, ASM Belgium N.V. (Belgium); Cyrus E. Tabery, ASML (USA); Etienne P. De Poortere, ASML Leuven (Belgium); Mark A. van de Kerkhof, ASML Netherlands B.V. (Netherlands); Eric Hendrickx, imec (Belgium) | 12751-6 • **Machine learning based defect sampling for weak pattern analysis,** Qian Xie, Siemens EDA (USA); Ku Fang, Chin-Juan Li, Garry Chen, Chia Wei Huang, Yen-chun Chen, Yung-Feng Cheng, United Microelectronics Corp. (Taiwan); Chuan-chun Lee, Siemens EDA (Taiwan); Le Hong, Siemens EDA (USA); Jack Lin, Siemens EDA (Taiwan); Fan Jiang, Siemens EDA (USA); Xiang Fang, Siemens EDA (Taiwan) |
| | 12750-9 • **A novel way of modelling plasma induced hydrogen permeation in metals,** Cederik Meekes, Dagmar A. Wismeijer, Jurjen Emmelkamp, Henk A. Lensen, TNO (Netherlands) | 12751-7 • **Die-to-database inspections of optical patterned masks,** Christopher F. Wieland, Kristy J. Kormondy, Annelise R. Beck, Britain J. Smith, Firoz Ghadiali, Jun Kim, Frank E. Abboud, Intel Corp. (USA); Tetsuya Sendoda, Naonari Kondo, Tomohiro Imahoko, Jeoung S. Kim, Lasertec USA (USA); Chikato Kaga, Arosha Goonesekera, Wonil Cho, Lasertec USA Inc. (USA); Sankaranarayanan Paninjath, Siemens Digital Industries Software, Inc. (India); Saikiran Madhusudhan, Siemens Digital Industries Software, Inc. (USA); Prakash Deep, Shivam Nln, Sasidhara R. Reddy, Ranganadh Peesapati, Siemens Digital Industries Software, Inc. (India) |
| | 12750-10 • **Systematic and stochastic placement error divergence between low and high-NA EUV lithography**, Anatoly Y. Burov, KLA Texas (USA); Roel Gronheid, KLA Corp. (Belgium); Alessandro Vaglio Pret, KLA Italy Srl (Italy) | 12751-8 • **AFM nanomachining and clean repair of EUV TaBN advanced absorber material,** Tod E. Robinson, Maria Jose E. Cadena, Bruker Corp. (USA) |
| STEINBECK LOBBY | Coffee Break • 3:20 PM - 3:50 PM | |
| 3:50 PM - 6:00 PM | **SESSION 3** • 3:50 PM - 6:00 PM<br>**Resist**<br>Session Chairs: **Marie E. Krysak,** Intel Corp. (USA)**; Chawon Koh,** SAMSUNG Electronics Co., Ltd. (Republic of Korea) | **SESSION 3** • 3:50 PM - 6:00 PM<br>**Curvilinear Mask Technologies**<br>Session Chairs: **Aki Fujimura,** D2S, Inc. (USA)**, Danping Peng,** TSMC North America (USA) |
| | 12750-11 • INVITED PAPER<br>**Advancements in EUV photoresists for high-NA lithography,** Aysegul Develioglu, Michaela Vockenhuber, Paul Scherrer Institut (Switzerland); Lidia van Lent-Protasova, ASML Netherlands B.V. (Netherlands); Iacopo Mochi, Yasin Ekinci, Dimitrios Kazazis, Paul Scherrer Institut (Switzerland) | 12751-201 • KEYNOTE PRESENTATION |
| | 12750-12 • INVITED PAPER<br>**Organic dry development rinse (O-DDR) process for MOR patterning toward High-NA EUV,** Satoshi Takeda, Wataru Shibayama, Kodai Kato, Shuhei Shigaki, Yuki Furukawa, Taiki Saijo, Makoto Nakajima, Rikimaru Sakamoto, Nissan Chemical Corp. (Japan) | 12751-9 • **Opportunities, challenges and applications of native curvilinear data representation in post-tape-out flows,** Bhardwaj S. Durvasula, Sayalee Gharat, Ranganadh Peesapati, Rachit Sharma, Siemens EDA (India); Ingo Bork, Stephen H. Kim, Siemens EDA (USA) |
| | 12750-13 • **Advanced development for contact-holes of metal-oxide resists,** Cong Que Dinh, Tokyo Electron Kyushu Ltd. (Japan); Seiji Nagahara, Tokyo Electron Ltd. (Japan); Kanzo Kato, TEL Technology Ctr., America, LLC (USA); Shinichiro Kawakami, Yuhei Kuwahara, Kayoko Cho, Soichiro Okada, Tokyo Electron Kyushu Ltd. (Japan); Kathleen McInerney, Lior Huli, TEL Technology Ctr., America, LLC (USA); Makoto Muramatsu, Tokyo Electron Kyushu Ltd. (Japan) | 12751-10 • **Leaping into the curvy world with GPU accelerated O(P) computing,** Abhishek Shendre, Aki Fujimura, D2S, Inc. (USA) |
| | 12750-14 • **A novel formulated developer and materials development for CAR-NTD to improve chemical stochastic,** Toru Fujimori, Keiyu Ou, Naohiro Tango, FUJIFILM Corp. (Japan) | 12751-11 • **ML-model based curvilinear mask error correction,** Linghui Wu, John Valadez, Jian Rao, Jim Burdorf, Yunqiang Zhang, Yongdong Wang, Alex Zepka, Folarin Latinwo, Synopsys, Inc. (USA) |
| | 12750-15 • **Analysis method to define photoresist resolution in EUV lithography,** Yongbeom Seo, Heeyoung Go, Jinseong Lee, Tae-Hwan Oh, Donghun Shin, Jisun Lee, Sang-Jin Kim, Insung Kim, Chang-min Park, SAMSUNG Electronics Co., Ltd. (Republic of Korea) | 12751-12 • **Deep learning-based detection of mask rule check violations in curvilinear mask,** Soo-Yong Lee, Jeeyong Lee, Sinjeung Park, Byungjoon Kang, Juyun Park, Bongkeun Kim, Joonsung Kim, Seung-Hune Yang, Seongtae Jeong, SAMSUNG Electronics Co., Ltd. (Republic of Korea) |
| | 12750-16 • **Recent Improvements in EUV lithography using multi-trigger Resist,** Carmen Popescu, Greg O'Callaghan, Alexandra McClelland, Catherine Storey, Irresistible Materials Ltd. (United Kingdom); John Roth, Edward A. Jackson, Nano-C, Inc. (USA); Alex P. G. Robinson, Univ. of Birmingham (United Kingdom) | 12751-13 • **Multibeam fracture flow based on multigon format input,** Apurva Bajpai, Rachit Sharma, Bhardwaj S. Durvasula, Ranganadh Peesapati, Sayalee Gharat, Siemens EDA (India); Stephen H. Kim, Siemens EDA (USA) |
| | 12750-17 • **EUV resists fundamental studies at NewSUBARU synchrotron light facility especially on EUV high-NA lithography,** Takeo Watanabe, Shinji Yamakawa, Tetsuo Harada, Univ. of Hyogo (Japan) | 12751-14 • **Novel method for precise curved EUV mask CD characterization by adopting machine learning,** Jaeseo Lee, Inhwan Noh, Youngsu Sung, Ji-hoon Kang, Seunghye Kim, Jin Choi, SAMSUNG Electronics Co., Ltd. (Republic of Korea) |
| | 12750-18 • **Modelling reactions in ESCAP polymers following EUV exposure via a chemical reaction network,** Jacob R. Milton, Frances A. Houle, Samuel M. Blau, Lawrence Berkeley National Lab. (USA) | |

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| 6:00 - 7:30 PM<br>**MONTEREY MARRIOTT, SAN CARLOS BALLROOM** | **POSTER SESSION—**<br>Symposium attendees are invited to attend the Poster Session on Monday evening. This session provides an opportunity for attendees to meet with colleagues, network, view posters and interact with the authors. Attendees are requested to wear their conference registration badges.<br>**POSTER SETUP: MONDAY 2:00 PM TO 6:00 PM** | |
| | 12750-51 • **Development of an ultra-compact inline transmission grating spectrograph for extreme ultraviolet wavelengths,** Sascha Brose, RWTH Aachen Univ. (Germany), JARA - Fundamentals of Future Information Technology (Germany); Serhiy Danylyuk, Fraunhofer-Institut für Lasertechnik ILT (Germany); Bernhard Lüttgenau, Ismael Gisch, RWTH Aachen Univ. (Germany), JARA - Fundamentals of Future Information Technology (Germany); Lars Lohmann, RWTH Aachen Univ. (Germany), JARA – Fundamentals of Future Information Technology (Germany); Jochen Stollenwerk, Carlo Holly, RWTH Aachen Univ. (Germany), Fraunhofer-Institut für Lasertechnik (Germany), JARA – Fundamentals of Future Information Technology (Germany) | 12751-59 • **CANCELED: Lithography blazing of mid-ir gratings to enable broadband high efficiency,** Trevor Chen, Spectral Energies, LLC (United States); Bangzhi Liu, Chad Eichfeld, The Pennsylvania State Univ. (United States); Daniel Thul, Paul Hsu, Spectral Energies, LLC (United States) |
| | 12750-52 • **Platinum-based alloy absorber with improved etching properties for next-generation EUV mask,** Yunsoo Kim, Dongmin Jeong, Seungho Lee, Jinho Ahn, Hanyang Univ. (Republic of Korea) | 12751-60 • **An advanced 2d feature transmitted algorithm for mask defect detection,** Yilei Zeng, Yi Cheng, Mengyao Jin, Hunter Li, Yuqin Hong, ChangXin Memory Technologies, Inc. (China) |
| | 12750-53 • **A holistic study on metal pitch uniformity control in the scheme of self-aligned double patterning**<br>Zhao Liu, Superstring Academy of Memory, Technology Beijing (China) | 12751-61 • **Research and optimization of electronic charge phenomena on CDSEM imaging of binary photomask,** Jiaying Luo, Irene Shi, Brian Zheng, Yuming Gan, Zhuowei Zhang, Tony Ge, Eric Guo, New Ray Mask Technology Corp. (China) |
| | 12750-54 • **Achievement of ultimate zero thermal expansion in super invar based alloy for stable optical systems,** Hiromichi T. Fujii, Naoki Sakaguchi, Haruyasu Ohno, Kotaro Ona, Shinhokoku Material Corp. (Japan) | 12751-62 • **Programmable photomask for photolithography systems,** Richard Beaudry, Digitho Technologies Inc. (Canada); Md. Iftekharul Islam, Amrid Amnache, Univ. de Sherbrooke (Canada); Maurice Delafosse, Digitho Technologies Inc. (Canada); Luc Fréchette, Univ. de Sherbrooke (Canada) |
| | 12750-55 • **Update on main chain scission resists in Zeon for high-NA EUV lithography,** Akihide Shirotori, Yuji Oda, Kazunori Taguchi, SinFu Yeh, Zeon Corp. (Japan); Hyo Seon Suh, Danilo De Simone, Geert Vandenberghe, imec (Belgium); Hideaki Sanuki, Zeon Corp. (Japan) | 12751-63 • **How to improve intra-field CDU of contact hole patterns in both x-y directions with CDC technology,** Yilei Zeng, Levi Tang, Xiuxuan Zhang, Yingjie Wang, Pei Su, ChangXin Memory Technologies, Inc. (China) |
| | 12750-56 • **Development progress of Sn-LPP EUV light source for inspection systems,** Yuichi Nishimura, Yoshifumi Ueno, Shinji Nagai, Fumio Iwamoto, Kenichi Miyao, Hideyuki Hayashi, Takuya Ishii, Tamotsu Abe, Hiroaki Nakarai, Takashi Saitou, Gigaphoton Inc. (Japan) | 12751-64 • **Optimized test pattern selection with machine learning method,** Peng Xu, Juan Wei, Jingkang Qin, Jinlai Liu, Guangyu Sun, Song Sun, Cuixiang Wang, Qingchen Cao, Jiangliu Shi, Beijing Superstring Academy of Memory Technology (China) |
| | 12750-57 • **Development of thermal emissivity calculation method for transmissive multilayer nanomembranes,** Kihun Seong, Korea Electronics Technology Institute (Republic of Korea), Sungkyunkwan Univ. (Republic of Korea); Yongkyung Kim, Korea Electronics Technology Institute (Republic of Korea), Hanyang Univ. (Republic of Korea); Hyeyoung Kim, Korea Electronics Technology Institute (Republic of Korea), Sungkyunkwan Univ. (Republic of Korea); Sung Kyu Jang, Korea Electronics Technology Institute (Republic of Korea); Sangsul Lee, Pohang Univ. of Science and Technology (Republic of Korea); Jiho Kim, Pohang Accelerator Lab. (Republic of Korea); Jaeboong Choi, Sungkyunkwan Univ. (Republic of Korea); Hyun-Mi Kim, Seul-Gi Kim, Hyeongkeun Kim, Korea Electronics Technology Institute (Republic of Korea) | 12751-66 • **Sem image contour extraction with deep learning method,** Junhao Gu, Beijing Superstring Academy of Memory Technology (China), Tsinghua Univ. (China); Peng Xu, Juan Wei, Song Sun, Qingchen Cao, Jiangliu Shi, Beijing Superstring Academy of Memory Technology (China); Xijin Zhao, Chun Zhang, Tsinghua Univ. (China) |
| | 12750-58 • **Exploring interactions between hydrogen plasma and construction materials,** Kleopatra Papamichou, Thomas Mechielsen, Aneta Stodólna, Erik Schuring, Henk A. Lensen, TNO (Netherlands) | 12751-67 • **Rounded-corner aware OPC for convergency and lithography performance improving,** Ruihua Liu, Fu Li, Song Sun, Chunlong Yu, Jingjing Fan, Yu Mu, Chong Wang, Jiangliu Shi, Qingchen Cao, Beijing Superstring Academy of Memory Technology (China) |
| | 12750-59 • **Study of electron-induced chemical transformations in model resists,** Maximillian W. Mueller, San José State Univ. (United States), Lawrence Berkeley National Lab. (United States); Terry R. McAfee, Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States); Dahyun Oh, San José State Univ. (United States); Oleg Kostko, Lawrence Berkeley National Lab. (United States)<br>2 October 2023 • 6:00 PM - 7:30 PM PDT \| Monterey Marriott, San Carlos Ballroom | 12751-68 • **High-brightness and compact LPP EUV source for inspection system,** Yasutsugu Usami, Yoshifumi Ueno, Shinji Nagai, Fumio Iwamoto, Takuya Ishii, Hiroaki Nakarai, Tsuyoshi Yamada, Gigaphoton Inc. (Japan) |
| | 12750-60 • **The X-ray absorption spectroscopy analysis of the negative-tone PAG bound resist,**<br>Shinji Yamakawa, Tetsuo Harada, Takeo Watanabe, Univ. of Hyogo (Japan) | 12751-71 • **Wo3 as a programmable electrochromic photomask for maskless lithography,** Chunyan Song, Westlake Univ. (China); Aibin Huang, Shanghai Institute of Ceramics (China), Univ. of Chinese Academy of Sciences (China); Yijian Chen, Westlake Univ. (China); Xun Cao, Shanghai Institute of Ceramics (China), Univ. of Chinese Academy of Sciences (China); Xijun Li, Westlake Univ. (China) |

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| 6:00 - 7:30 PM<br>MONTEREY MARRIOTT, SAN CARLOS BALLROOM | 12750-61 • **Fizeau interferometry for evaluating EUV attenuated phase shift mask,** Donggi Lee, Seungchan Moon, Jin Hyuk Choi, Seok Ho Song, Jinho Ahn, Hanyang Univ. (Republic of Korea) | 12751-72 • **Quantitative study of local MEEF of 2D mask corrected by inverse lithography technology,** Futian Wang, Song Sun, Chunlong Yu, Yu Mu, Juan Wei, Cuixiang Wang, Liang Li, Qingchen Cao, Miao Jiang, Peng Xu, Beijing Superstring Academy of Memory Technology (China); Joshua Jeong, Yilei Zeng, Andy Lan, ChangXin Memory Technologies, Inc. (China); Jiangliu Shi, Beijing Superstring Academy of Memory Technology (China) |
| | 12750-62 • **Experimental investigation of the mask diffraction light blocking with critical-sized Sn particles on the EUV pellicle,** Seungchan Moon, Donggi Lee, Jin Hyuk Choi, Jinho Ahn, Hanyang Univ. (Republic of Korea) | 12751-73 • **Identifying new absorber materials for EUV photomasks,** Rebecca D. Stern, Applied Materials, Inc. (United States); Michael Grimbergen, Applied Materials (United States); Jeff Chen, Rao Yalamanchili, Applied Materials, Inc. (United States) |
| | 12750-63 • **Functional surface treatment process and primers for extremely enhancing EUVL performance,** Taiki Saijo, Yuki Furukawa, Shuhei Shigaki, Satoshi Takeda, Wataru Shibayama, Makoto Nakajima, Rikimaru Sakamoto, Kodai Kato, Nissan Chemical Corp. (Japan) | 12751-74 • **Research of mask photoresist sensitivity for local critical dimension uniformity improvement in ARF lithography,** Yilei Zeng, Yi Cheng, Yu Zhang, Peisheng Li, Zhong Zhang, Min Zhou, ChangXin Memory Technologies, Inc. (China) |
| | 12750-64 • **Track solutions for enhanced resist stability: A leap towards high-NA EUVL manufacturability,** Andreia Santos, Elke Caron, Wesley Zanders, SCREEN SPE Germany GmbH (Belgium); Seonggil Heo, Jelle Vandereyken, imec (Belgium); Masahiko Harumoto, SCREEN Semiconductor Solutions Co., Ltd. (Japan) | 12751-75 • **The process-footprint and density-dependent errors correction of laser mask pattern generator with software-based data path for cd uniformity improvement,** Hsiang Jen Yang, Po-Sheng Wang, Yen-Hao Chen, Sheng-Hsin Sun, Ting-Ching Hu, Chia-Wei Lin, Taiwan Mask Corp. (Taiwan); Lance Lin, Applied Materials Taiwan, Ltd. (Taiwan) |
| | 12750-65 • **Showcasing EUV process stability and defect control on SCREEN's DT-3000 track,** Elke Caron, Andreia Santos, Wesley Zanders, SCREEN SPE Germany GmbH (Belgium); Jelle Vandereyken, Seonggil Heo, imec (Belgium); Masahiko Harumoto, SCREEN Semiconductor Solutions Co., Ltd. (Japan) | 12751-76 • **Dense mask registration fingerprint characterization to better understand and mitigate the metrology to device offset,** Richard J. F. van Haren, ASML Netherlands B.V. (Netherlands); Steffen Steinert, Carl Zeiss SMT GmbH (Germany); Orion Mouraille, Oktay Yildirim, ASML Netherlands B.V. (Netherlands); Jan Hermans, imec (Belgium); Leon van Dijk, ASML Netherlands B.V. (Netherlands); Dirk Beyer, Carl Zeiss SMT GmbH (Germany) |
| | 12750-66 • **Deep learning denoiser assisted roughness measurements extraction from thin resists with low signal-to-noise-ratio (SNR) SEM Images: analysis with SMILE,** Sara Sacchi, Univ. degli Studi di Bologna (Italy), imec (Belgium); Bappaditya Dey, Bhavishya Chowrira, imec (Belgium); Iacopo Mochi, Paul Scherrer Institut (Switzerland); Sandip Halder, Philippe Leray, imec (Belgium) | 12751-77 • **Molecular identification of nanoscale defects and ultrathin residues with IR PiFM,** Derek Nowak, Padraic O'Reilly, Molecular Vista, Inc. (United States); Brian Grennon, Grennon Consulting, Inc. (United States); Sung Park, Molecular Vista, Inc. (United States) |
| | 12750-67 • **High-resolution silicon pore x-ray optics,** Boris Landgraf, Nicolas Barrière, Alex Bayerle, Maximilien Collon, David Girou, Laurens Keek, Adam Lassise, Giuseppe Vacanti, Aniket Thete, Ramses Gunther, Christian Koernig, Mark Vervest, Luc Voruz, cosine measurement systems (Netherlands) | 12751-78 • **A study on the imaging characteristics of phase shift mask for EUV technology with novel material,** Minkyu Park, Mikyung Woo, Gyeongwon Seo, Yongdae Kim, Chulkyu Yang, Jonghwa Lee, Cheol Shin, S&S Tech Co. Ltd. (Republic of Korea) |
| | 12750-68 • **The EUV optical constants of high and low density diamond-like carbon – Mask blanks and pellicles,** Mohammad Saghayezhian, Jojo Daof, Katrina Rook, Antonio Checco, Meng Lee, Marjorie Chee, Veeco Instruments Inc. (United States) | 12751-79 • **Efficient representation of full mask density maps in advanced mask data preparation flows,** Rachit Sharma, Siemens Digital Industries Software, Inc. (India); Ingo Bork, Siemens Digital Industries Software, Inc. (United States); Archana Rajagopalan, Kushlendra Mishra, Siemens EDA (India); Mary Zuo, Siemens EDA (United States) |
| | 12750-69 • **Sequence-defined metal-binding peptoids for high-resolution patterning in extreme ultraviolet (EUV) lithography,** Chenyun Yuan, Cornell Univ. (United States); Cameron P. Adams, Univ. of California, Santa Barbara (United States); Brett A. Helms, Lawrence Berkeley National Lab. (United States); Rachel A. Segalman, Univ. of California, Santa Barbara (United States); Christopher K. Ober, Cornell Univ. (United States) | 12751-81 • **A formulation of mask optimization into QUBO model for Ising machines,** Yukihide Kohira, Haruki Nakayama, Naoki Nonaka, Univ. of Aizu (Japan); Tomomi Matsui, Atsushi Takahashi, Tokyo Institute of Technology (Japan); Chikaaki Kodama, KIOXIA Corp. (Japan) |
| | 12750-70 • **A study on euv light interaction with colloidal nanoparticles,** Saurav Mohanty, Ethan Flores, Chih-Hao Chang, The Univ. of Texas at Austin (United States) | 12751-82 • **A simulation-based methodology to analyze the impact of edge-length on curvilinear mask accuracy,** Kushlendra Mishra, Rachit Sharma, Siemens Digital Industries Software, Inc. (India); Ingo Bork, Mary Zuo, Siemens Digital Industries Software, Inc. (United States); Christof Zillner, IMS Nanofabrication GmbH (Austria) |
| | 12750-71 • **Flexible, actinic EUV mask blank reflectometer EUV-MBR 4.0,** Rainer Lebert, Andreas Biermanns-Foeth, Christoph Phiesel, Thomas Missalla, RI Research Instruments GmbH (Germany) | 12751-83 • **A study of applying mask process correction to constant width curvilinear SRAFS,** Mary Zuo, Siemens Digital Industries Software, Inc. (United States); Kushlendra Mishra, Rachit Sharma, Siemens Digital Industries Software, Inc. (India); Ingo Bork, Siemens Digital Industries Software, Inc. (United States); Nassima Zeggaoui, Siemens Digital Industries Software, Inc. (France) |
| | 12750-72 • **High-brightness LDP source,** Kazuya Aoki, Teruaki Kawajiri, Koji Suzuki, Shunichi Morimoto, Hidenori Watanabe, Akihisa Nagano, Daisuke Yajima, Ryuta Furuya, Noriaki Ashizawa, Yoshihiko Sato, Ushio Inc. (Japan); Yusuke Teramoto, Ushio Inc. (Germany); Masataka Mamizuka, Ushio Inc. (Japan) | 12751-84 • **Improving overlay performance through enhanced stage positioning accuracy,** James Prince, Victor David, Diana Poullos, Larry S. Zurbrick, Keysight Technologies, Inc. (United States) |

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| 6:00 - 7:30 PM<br>MONTEREY MARRIOTT, SAN CARLOS BALLROOM | 12750-73 • **Thermomechanical effect on the extreme-ultraviolet pellicle lifetime,** Ji-Hyun Jeon, Ji-Won Kang, Hee-Chang Ko, Hye-Keun Oh, Hanyang Univ. (Republic of Korea) | 12751-85 • **Aerial imaging (aims) based computational lithography model calibration and mask metrology for high-NA EUV,** Nitesh Pandey, Stefan Hunsche, ASML (United States); Adam Lyons, ASML US, Inc. (United States); Christoph Hennerkes, ASML (United States); Andreas Verch, Maximilian Albert, Grizelda Kersteen, Renzo Capelli, Carl Zeiss SMT GmbH (Germany); Werner Gillijns, Balakumar Baskaran, Joost Bekaert, imec (Belgium) |
| | 12750-74 • **Influence of surface free energy of underlayer on the dissolution of resist film in tetramethylammonium hydroxide (TMAH) aqueous solution,** Jiahao Wang, Yukiko Sasaki, Takahiro Kozawa, SANKEN, Osaka Univ. (Japan) | 12751-86 • **Mask optimization approach for wafer LCDU improvement in ArF lithography,** Kenjiro Ichikawa, Itaru Yoshida, Toppan Photomask Co., Ltd. (Japan) |
| | 12750-76 • **Automatic evaluation of line-and-space resist patterns with defects using image recognition technology,** Yuqing Jin, Takahiro Kozawa, Yasushi Makihara, Kota Aoki, Tomoya Nakamura, Yasushi Yagi, SANKEN, Osaka Univ. (Japan) | 12751-87 • **Renewing i-line laser mask writers with reduced power consumption and increased productivity,** Thomas Peoples, Applied Materials, Inc. (United States) |
| | 12750-78 • **High Power EUV Irradiation tool with EUV-Induced Hydrogen Plasma at NewSUBARU,** Tetsuo Harada, Shinji Yamakawa, Takeo Watanabe, Univ. of Hyogo (Japan) | 12751-88 •**Improvement of auto defect classification and wafer impact expectation techniques for EUV mask productivity,** Wook Chang, Hyunwoo Min, In-yong Kang, Geunbae Kim, Sanghee Lee, SAMSUNG Electronics Co., Ltd. (Republic of Korea); Donghwan Son, Taekwon Lee, Jiuk Hur, Vikram L. Tolani, Paul Chung, Suresh Lakkapragada, Zeyu Lei, Masaki Satake, Frank Liao, Jing Jiao, Kana Ohara, Peter Hu, Janny Wang, Will Wang, Yifu Wang, Yan Zheng, Derui Li, George Hwa, Erik Kwon, KLA Corp. (United States) |
| | 12750-79 • **Thermal deformation variations with field positions on the wafer and resist types (CAR and MOR),** Hee-Chang Ko, Ji-Won Kang, Min-Woo Kim, Hye-Keun Oh, Hanyang Univ. (Republic of Korea) | 12751-93 • **Programmable photomask for photolithography systems,** Richard Beaudry, Digitho Technologies Inc. (Canada); Iftekharul Islam, Amrid Amnache, Université de Sherbrooke (Canada); Maurice Delafosse, Digitho Technologies Inc. (Canada); Luc Fréchette, Université de Sherbrooke (Canada) |
| | 12750-80 • **Holistic litho-etch approach towards high NA EUV challenges,** Soichiro Okada, Arnaud Dauendorffer, Yuhei Kuwahara, Satoru Shimura, Tokyo Electron Kyushu Ltd. (Japan); Philippe Foubert, Danilo De Simone, imec (Belgium); Cong Que Dinh, Tokyo Electron Kyushu Ltd. (Japan); Atsushi Tsuboi, Tokyo Electron Ltd. (Japan); Kathleen Nafus, Tokyo Electron America Inc. (Belgium) | 12751-125 • **Next generation particle detection metrology tool for EUV pellicles and mask backside defectivity control,** Hans Arts, FastMicro B.V. (United States); Hendrik Ketelaars, FastMicro B.V. (Netherlands) |
| | 12750-81 • **Direct growth of highly uniform graphite on SiNx/Si through metal induced crystallization of amorphous carbon for EUV pellicle,** Hyeyoung Kim, Jun-Hyeok Jeon, Kihun Seong, Yongkyung Kim, Seul-Gi Kim, Hyun-Mi Kim, Hyeongkeun Kim, Korea Electronics Technology Institute (Republic of Korea); Ji-Beom Yoo, Sungkyunkwan Univ. (Republic of Korea) | |
| | 12750-82 • **Metrology development on latent images via critical-dimension resonant soft x-ray scattering,** Qi Zhang, Weilun Chao, Warren Holcomb, Ryan Miyakawa, Ricardo Ruiz, Dinesh Kumar, Lawrence Berkeley National Lab. (United States); Andrew Neureuther, Univ. of California, Berkeley (United States); Patrick Naulleau, Cheng Wang, Lawrence Berkeley National Lab. (United States) | |
| | 12750-83 • **Curvilinear mask embodiment for high NA: an imaging perspective,** Parul Dhagat, Sofia Leitao, Sander Blok, Laurens de Winter, Eelco van Setten, ASML Netherlands B.V. (Netherlands) | |
| | 12750-84 • **Comparison of photoresist sensitivity between KrF, EB, and EUV exposure,** Yosuke Ohta, Atsushi Sekiguchi, Litho Tech Japan Co., Ltd. (Japan); Takeo Watanabe, Tetsuo Harada, Shinji Yamakawa, Univ. of Hyogo (Japan); Hiroki Yamamoto, National Institute for Quantum Science and Technology (Japan) | |
| | 12750-24 • **In-depth monitoring of optical performance in EUV lithography system** *(Invited Paper),* Teun Boeren, Eunhee Jeang, Donghyeong Kim, SAMSUNG Electronics Co., Ltd. (Republic of Korea) | |
| | 12750-85 • **Health inspection of EUV pellicles with emphasis on CNT pellicles,** Jochen Mielke, ; Emile van Veldhoven, Jarkku Etula, Canatu Oy (Finland); Christoph Lenz, Roland Seitz, HORIBA Jobin Yvon GmbH (Germany); Kosuke Matsumoto, HORIBA Ltd. (Japan); Dustin Hoeffel, HORIBA Instruments Inc. (United States) | |
| | 12750-87 • **CANCELED: Insights from 3D imaging and characterization of EUV resist using high speed probe metrology,** Andrew Humphris, John W. Cossins, Lei Feng, Infinitesima Ltd. (United Kingdom) | |

| TIME | CONFERENCE 12750<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 3<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12750<br>**International Conference on Extreme Ultraviolet Lithography 2023** | CONFERENCE 12751<br>LOCATION: MONTEREY CONF. CTR., STEINBECK 2<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12751<br>**Photomask Technology 2023** |
|---|---|---|
| | **TUESDAY 3 OCTOBER** | |
| MORNING<br>8:30 AM - 10:00 AM | **SESSION 4** • 8:30 AM - 10:00 AM<br>**OPC**<br>Session Chairs: **Eric M. Panning,** Lavorro Inc. (USA); **Patrick P. Naulleau,** The Ctr. for X-Ray Optics (USA) | **SESSION 4** • 8:30 AM - 10:00 AM<br>**Emerging Applications: AR/VR & Advanced Packaging**<br>Session Chairs: **Lawrence S. Melvin,** Synopsys, Inc. (USA); **Nihar Mohanty,** Meta (USA) |
| | 12750-19 • INVITED PAPER<br>**Rigorous 3D probabilistic computational lithography and chip level inspection for EUV stochastic failure detection,** Eunju Kim, Nohong Kwak, Mincheol Kang, Seongjong Kim, Wooseok Kim, Yongchul Jeong, Myungsoo Hwang, Chang-Min Park, Kyoil Koo, Seongtae Jeong, SAMSUNG Electronics Co., Ltd. (Republic of Korea); John J. Biafore, Mark D. Smith, KLA Corp. (USA); Trey Graves, Anatoly Y. Burov, KLA Texas (USA); Pradeep Vukkadala, Guy Parsey, Cao Zhang, Kunlun Bai, Janez Krek, KLA Corp. (USA); Craig D. Higgins, KLA Texas (USA); Sergei Bakarian, Kyeongeun Ko, Roel Gronheid, Kaushik Sah, KLA Corp. (USA); Andrew J. Cross, KLA England (USA); Yi Liu, KLA Texas (USA); Alessandro Vaglio Pret, KLA Italy Srl (USA); Vikram L. Tolani, George Hwa, Peter Hu, Chang Song, Alexandre Arkhipov, KLA Corp. (USA); Loemba Bouckou, KLA Italy Srl (USA); Chi-Ping Liu, Xiaochun Yang, Kana Ohara, Donghwan Son, KLA Corp. (USA) | 12751-15 • INVITED PAPER<br>**Lithography challenges in high quality surface relief gratings for augmented reality application,** Yongan Xu, Applied Materials, Inc. (USA) |
| | 12750-20 • INVITED PAPER<br>**Measurement of imaging fading impact on 20P40 contact hole LCDU using actuated overlay corrections,** Sam Borman, Dominykas Gustas, Hilbert van Loo, Tian Gang, Dorothe Oorschot, Andreas Brouwer, Alberto Colina, Frank Horsten, Tasja van Rhee, ASML Netherlands B.V. (Netherlands) | 12751-16 • INVITED PAPER<br>**Metastructures: envision the future for immersive augmented reality,** Bo Zhao, Meta (USA) |
| | 12750-22 • **Accelerating EUV lithography simulation with weakly guiding approximation and extended TCC formula,** Hiroyoshi Tanabe, Akira Jinguji, Atsushi Takahashi, Tokyo Institute of Technology (Japan) | 12751-17 • INVITED PAPER<br>**Lithography solutions enabling advanced packaging and heterogeneous integration applications,** Doug Shelton, Canon U.S.A., Inc. (USA) |
| | 12750-23 • **Mask error and its contribution to OPC model error for an EUV via layer,** Adam Lyons, Thomas I. Wallow, Chris Spence, ASML (USA); Brid Connolly, Toppan Photomasks Co LTD (Germany); Christian Beurgel, Markus Bender, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) | 12751-18 • **Displacement talbot lithography process simulation analysis,** Lawrence S. Melvin, Andrew M. C. Dawes, Synopsys, Inc. (USA); Bernd Kuechler, Synopsys, Inc. (Germany); Wolfgang Demmerle, Synopsys, Inc. (USA); Zhixin Wang, Haron H. Solak, Eulitha AG (Switzerland); Kelsey Wooley, Eulitha US, Inc. (USA) |
| | | 12751-19 • **Nanoimprint performance improvements for high volume semiconductor device manufacturing,** Hideo Tanaka, Canon Inc. (Japan) |
| EXHIBITION HALL, STEINBECK 1 | Coffee Break • 10:00 AM - 10:25 AM | |
| 10:25 AM - 12:20 PM | **SESSION 5** • 10:25 AM - 12:20 PM<br>**Metrology**<br>Session Chairs: **Patrick P. Naulleau,** The Ctr. for X-Ray Optics (USA); **Geert Vandenberghe,** imec (Belgium) | **SESSION 5** • 10:25 AM - 12:20 PM<br>**Blank Technology**<br>Session Chairs: **Takahiro Onoue,** HOYA Corp. (Japan); **Claire van Lare,** ASML Netherlands B.V. (Netherlands) |
| | 12750-25 • INVITED PAPER<br>**Resolution and patterning performance quantification using efficient e-beam metrology,** Cyrus E. Tabery, Miao Wang, ASML (USA); Victor Blanco Carballo, Eren Canga, imec (Belgium); Aiqin Jiang, Chris Spence, Thomas I. Wallow, ASML (USA) | 12751-20 • INVITED PAPER<br>**Actinic blank inspection for high-NA EUV lithography,** Tomohiro Suzuki, Ryo Watanabe, Shohei Sakuma, Tomoro Ide, Lasertec Corp. (Japan) |
| | 12750-26 • **Probing EUV resist defect detectability using a SEM simulation framework,** Thomas I. Wallow, Aiqin Jiang, ASML (USA); Ton Kiers, ASML Netherlands B.V. (Netherlands); Tim Houben, Technische Univ. Delft (Netherlands); Chris Spence, ASML (USA) | 12751-21 • INVITED PAPER<br>**Ion beam deposition for larger form-factor EUV mask blanks and pellicles ,** Katrina Rook, Mario Roque, Antonio Checco, Marjorie Chee, Meng H. Lee, Veeco Instruments Inc. (USA) |
| | 12750-27 • **NIST efforts in extreme-ultraviolet metrology,** Charles Tarrio, National Institute of Standards and Technology (USA) | 12751-22 • **New EUV mask blank for N3 technology node and beyond,** Chung Yang Huang, Shi-Hao Yang, Wei-Ting Chen, Chien-Min Lee, Shy-Jay Lin, Chun-lang Chen, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Yoshiaki Ikuta, Tomohiko Satoh, Yosuke Nakakita, AGC Inc. (Japan) |
| | 12750-28 • **Improvements in the measurement of local critical dimension uniformity for holes and pillars,** Chris A. Mack, Fractilia, LLC (USA); Gian Lorusso, Danilo De Simone, imec (Belgium) | 12751-23 • **Influence of inhomogeneities on the reflectance and optical efficiency of MO/SI multilayers for EUV mask blanks,** Antonio Checco, Katrina Rook, Mohammad Saghayezhian, Kenji Yamamoto, Meng H. Lee, Ashish Kulkarni, Veeco Instruments Inc. (USA) |
| | 12750-29 •,**Advances in edge placement error metrology in the era of stochastics,** Chris A. Mack, Fractilia, LLC (USA); Mike Adel, Intellectual Landscapes (Israel) | 12751-24 • **Effects of EUV multilayer roughness on attenuated phase shift mask design,** Luke T. Long, Stuart Sherwin, EUV Technology (USA); Ryan Miyakawa, Lawrence Berkeley National Lab. (USA); Thomas V. Pistor, Panoramic Technology Inc. (USA); Patrick Naulleau, EUV Technology (USA) |

| TIME | CONFERENCE 12750<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 3<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12750<br>**International Conference on Extreme Ultraviolet Lithography 2023** | CONFERENCE 12751<br>LOCATION: MONTEREY CONF. CTR., STEINBECK 2<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12751<br>**Photomask Technology 2023** |
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| 10:25 AM - 12:20 PM | 12750-30 • **New technique for measuring free-form wafer shape for feed-forward overlay corrections,** Kiril I. Kurteva, Wooptix, S.L. (Spain); Jan O. Gaudestad, Wooptix, S.L. (USA); Juan M. Trujillo-Sevilla, Guillermo Castro Luis, Wooptix, S.L. (Spain); Richard van Haren, Leon van Dijk, Ronald Otten, ASML Netherlands B.V. (Netherlands) | 12751-25 • **New materials and their architectures for EUV photomasks,** Supriya L. Jaiswal, Astrileux Corp. (USA) |
| | 12750-124 • **Multi-column e-beam inspection system for advanced EUV reticles,** Kunal Rohilla, David Aupperle, Wenxing Jiang, KLA Corp. (USA); Seungtak Seo, Sanguk Park, Jongju Park, Jin Choi, Sanghee Lee, SAMSUNG Electronics Co., Ltd. (Republic of Korea); Min Choo, Yeonjeong Choi, Paul Chung, KLA Corp. (Republic of Korea) | 12751-26 • **Proposal of novel EUV phase shift mask,** Hiroshi Hanekawa, AGC Inc. (Japan); Taiga Fudetani, AGC Electronics Co., Ltd. (Japan); Takeshi Tomizawa, Yoshiaki Ikuta, AGC Inc. (Japan) |
| 12:20 PM - 1:45 PM<br>MONTEREY CONF. CTR., STEINBECK 1 | Lunch/Exhibition Break • 12:20 PM - 1:45 PM<br>DESSERT IN EXHIBITION HALL • 1:15 PM - 1:45 PM<br>Enjoy dessert in the Exhibition Hall while networking with exhibitors. | |
| AFTERNOON<br>1:45 PM - 3:15 PM | | **SESSION 6** • 1:45 PM - 3:15 PM<br>**Special Invited Topics on Mature Technologies**<br>Session Chairs: **Kent H. Nakagawa,** Toppan Photomasks, Inc. (USA); **Henry H. Kamberian,** Photronics, Inc. (USA) |
| | | 12751-27 • INVITED PAPER<br>**Factors driving merchant photomask growth and shortages,** Bud T. Caverly, Les B. Dahl, Toppan Photomasks, Inc. (USA) |
| | | 12751-28 • INVITED PAPER<br>**Use of advanced data modeling to introduce and extend mask tools serving mainstream application,** Mohamed Ramadan, Christopher J. Progler, Michael Green, Henry H. Kamberian, Jinju Beineke, Photronics, Inc. (USA) |
| | | 12751-29 • INVITED PAPER<br>**The SLX journey: Designing a cost-efficient laser mask writer for today's and tomorrow's maskshop requirements,** Robert Eklund, Mikael L. Wahlsten, Mats O. Rosling, Martin Glimtoft, Peter Henriksson, Anders Svensson, Fredric Ihren, Mycronic AB (Sweden); Youngjin Park, Mycronic Co., Ltd. (Republic of Korea) |
| | | 12751-30 • INVITED PAPER<br>**MBMW-100 flex, the 1st electron multi-beam mask writer for mature and advanced mask nodes,** Mathias Tomandl, Christof Klein, Hans Loeschner, Elmar Platzgummer, IMS Nanofabrication GmbH (Austria) |
| | | 12751-31 • INVITED PAPER<br>**Providing solutions for replacement of legacy tools with advanced features,** Hideaki Hamada, Kazunari Egami, Shoji Kanai, Atma R. Gupta, Shingo Murakami, Katsuhiko Nakanishi, Ryota Uemura, Ken-ichi Matsumura, Achintya K. Acharya, HTL Co. Japan Ltd. (Japan) |
| | | 12751-32 • INVITED PAPER<br>**Efficient patterning approaches for non-Manhattan layouts by using variable shaped beam systems,** Ines A. Stolberg, Eike Linn, Matthias Slodowski, Ulf Weidenmueller, Vistec Electron Beam GmbH (Germany) |
| EXHIBITION HALL, STEINBECK 1 | Coffee Break • 3:15 PM - 3:45 PM | |

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| TIME | CONFERENCE 12750<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 3<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12750<br>**International Conference on Extreme Ultraviolet Lithography 2023** | CONFERENCE 12751<br>LOCATION: MONTEREY CONF. CTR., STEINBECK 2<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12751<br>**Photomask Technology 2023** |
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| AFTERNOON<br>3:45 PM - 5:05 PM | | **SESSION 7** • 3:45 PM - 5:05 PM<br>**Mask Patterning and Defects**<br>Session Chairs: **Ray Shi,** KLA Corp. (USA); **Dong-Seok Nam,** ASML (USA) |
| | | 12751-33 • INVITED PAPER<br>**EUV pod design and preventive maintenance for EUV mask handling and protection,** Huaping Wang, Russ Raschke, Phil Glynn, Entegris, Inc. (USA) |
| | | 12751-34 • **UV reticle defectivity: next steps in the EUV scanner and beyond**, Derk Brouns, ASML Netherlands B.V. (Netherlands) |
| | | 12751-35 • **EUV mask patterning process to enable opaque SRAFS for bright field EUV mask imaging,** Michael Green, Photronics, Inc. (USA); Jed Rankin, Scott Halle, Martin Burkhardt, Romain Lallement, IBM Corp. (USA); Mohamed Ramadan, Henry H. Kamberian, Jinju Beineke, Chris Progler, Photronics, Inc. (USA) |
| | | 12751-36 • **Simultaneous 3d characterization and repair of EUV mask defects,** Sang-Joon Cho, Byoung-Woon Ahn, Ah-Jin Jo, Park Systems Corp. (Republic of Korea); Brian Grenon, Grenon Consulting, Inc. (USA); Yong-Woon Lim, Seung Yeon Sung, Dongchun Lee, Park Systems Corp. (Republic of Korea) |
| | | 12751-37 • **Study of cross-linking influence on lithographic performance for EB resist,** Kei Yamamoto, Kotaro Takahashi, FUJIFILM Corp. (Japan) |
| **WEDNESDAY 4 OCTOBER** | | |
| 8:20 AM - 9:40 AM<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 2/3 | **Wednesday Plenary Session**<br>Session Chairs: **Seong-Sue Kim,** Seoul National Univ. (Republic of Korea); **Eric M. Panning,** Lavorro Inc. (USA)<br>**Shaping the future: The power of advanced OPC and mask technology** (Plenary Presentation), **Linda K. Somerville,** Micron Technology, Inc. (USA)<br>**Directions, challenges and opportunities in heterogeneous integration** (Plenary Presentation), **Ravi Mahajan,** Intel Corp. (USA) | |
| EXHIBITION HALL, STEINBECK 1 | Coffee Break • 9:40 AM - 10:05 AM | |
| 10:05 AM - 11:55 AM | **SESSION 6** | **SESSION 8** |
| | **JOINT SESSION WITH PHOTOMASK TECHNOLOGY AND EUV CONFERENCES**<br>**EUVL Extension (Low-NA)**<br>Session Chair: **Bryan S. Kasprowicz,** HOYA Corp. USA (USA) | |
| | 12750-31 • INVITED PAPER<br>**The International Roadmap for Devices and Systems (IRDS) is paving the way for CHIPS ACTS around the world!,** Paolo A. Gargini, IEEE (USA) | |
| | 12751-38 • INVITED PAPER<br>**EUV APSM mask prospects and challenges,** Shy-Jay Lin, Chien-Min Lee, Yen-Liang Chen, Lee-Feng Chen, Kuo-Lun Tai, Chien-Chao Huang, Frankie F. G. Tsai, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) | |
| | 12751-39 • INVITED PAPER<br>**Consolidated design approach to EUV mask blanks with TaBN based absorber ,** Takahiro Onoue, Naoki Hayase, Kazutake Taniguchi, Hitoshi Maeda, Teiichiro Umezawa, HOYA Corp. (Japan) | |
| | 12751-40 • INVITED PAPER<br>**Development and implementation of metrology infrastructure for EUV phase shift mask in production,** Elba Gomar-Nadal, Malahat Tavassoli, Kowtilya Bijjula, Intel Corp. (USA); Stuart Sherwin, Matt Hettermann, Christian Wilson, Feng Dong, Dave Houser, Alexander Khodarev, Chami Perera, Patrick Naulleau, EUV Technology (USA) | |
| | 12750-32 • INVITED PAPER<br>**Coater/Developer-based patterning techniques to achieve tight pitches with 0.33 NA single exposure,** Kanzo Kato, Lior Huli, Nathan Antonovich, David Hetzer, Alexandra Krawicz, Nayoung Bae, Eric Liu, Akiteru Ko, TEL Technology Ctr., America, LLC (USA); Satoru Shimura, Shinichiro Kawakami, Dinh Conque, Tokyo Electron Kyushu Ltd. (Japan); Takahiro Kitano, Seiji Nagahara, Tokyo Electron Ltd. (Japan); Luciana Meli, Indira Seshadri, Martin Burkhardt, Karen Petrillo, IBM Corp. (USA); Steven Grzeskowiak, TEL Technology Ctr., America, LLC (USA) | |
| 11:55 AM - 1:20 PM<br>MONTEREY CONF. CTR., STEINBECK 1 | Lunch/Exhibition Break • 11:55 AM - 1:20 PM<br>DESSERT IN EXHIBITION HALL • 1:00 PM - 1:20 PM<br>Enjoy dessert in the Exhibition Hall while networking with exhibitors. | |

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| TIME | CONFERENCE 12750<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 3<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12750<br>**International Conference on Extreme Ultraviolet Lithography 2023** | CONFERENCE 12751<br>LOCATION: MONTEREY CONF. CTR., STEINBECK 2<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12751<br>**Photomask Technology 2023** |
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| AFTERNOON<br>1:20 PM -<br>3:20 PM | **SESSION 7** • 1:20 PM - 3:20 PM<br>**Resist Fundamentals**<br>Session Chairs: **Takahiro Kozawa,** SANKEN, Osaka Univ. (Japan); **Jara G. Garcia-Santaclara,** ASML Netherlands B.V. (Netherlands) | **SESSION 9** • 1:20 PM - 3:20 PM<br>**Mask Metrology**<br>Session Chairs: **Ray Shi,** KLA Corp. (USA); **Dong-Seok Nam,** ASML (USA) |
| | 12750-33 • INVITED PAPER<br>**Functional underlayers for dose reduction and collapse mitigation in EUV lithography: a factorial analysis,** Roberto Fallica, Danilo De Simone, Weizhong Huang, imec (Belgium); Douglas J. Guerrero, Brewer Science, Inc. (USA); Kodai Kato, Nissan Chemical Corp. (Japan); Hyo Seon Suh, imec (Belgium) | 12751-41 • INVITED PAPER<br>**Research activities on EUV mask at NewSUBARU synchrotron light facility for the advanced EUV lithography,** Takeo Watanabe, Tetsuo Harada, Shinji Yamakawa, Univ. of Hyogo (Japan) |
| | 12750-34 • INVITED PAPER<br>**Nanoscale chemical metrology on latent EUV resist images,** Padraic O'Reilly, Molecular Vista, Inc. (USA); Luke Long, EUV Technology (USA); Warren Holcomb, Lawrence Berkeley National Lab. (USA); Thomas Albrecht, Molecular Vista, Inc. (USA); Brian Grenon, Grenon Consulting, Inc. (USA); Patrick P. Naulleau, Lawrence Berkeley National Lab. (USA), EUV Technology (USA); Sung Park, Molecular Vista, Inc. (USA) | 12751-43 • INVITED PAPER<br>**Realizing EUV photomask defectivity qualification by actinic mask review system,** Jiun-Lung Lu, Chien-Hsing Lu, Hsin-Fu Tseng, Chih-Wei . Wen, Chun-Hung Chen, Yi-An Huang, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Sagar V. Trivedi, Danping Peng, TSMC North America (USA); Hiroki Miyai, Takayuki Morisawa, Lasertec Corp. (Japan) |
| | 12750-35 • INVITED PAPER<br>**Predicting resist pattern collapse in EUVL using machine learning,** Sean D'Silva, Raghunandan Arava, Andreas Erdmann, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany); Thomas Muelders, Hans-Juergen Stock, Synopsys GmbH (Germany) | 12751-44 • **Towards fast ptychography image reconstruction of EUV masks by deep neural networks,** Paolo Ansuinelli, Benjamin Bejar, Yasin Ekinci, Iacopo Mochi, Paul Scherrer Institut (Switzerland) |
| | 12750-75 • **Sequence-defined polypeptoids as DUV and EUV chemically amplified resists,** Cameron P. Adams, Xiangxi Meng, Univ. of California, Santa Barbara (USA); Florian H. Kaefer, Chenyun Yuan, Christopher K. Ober, Cornell Univ. (USA); Rachel A. Segalman, Univ. of California, Santa Barbara (USA) | 12751-45 • **Optimizing CD-SEM metrology for anamorphic high-NA EUV photomasks,** Deepan Kishore Kumar, Varun Mohan, Hatsey W. Frezghi, Adam A. Seeger, Malahat A. Tavassoli, Intel Corp. (USA); Masayuki Kuribara, Advantest Corp. (Japan); Kiyoshi Oura, Wataru Ito, Advantest America, Inc. (USA); Soichi Shida, Tatsuro Okawa, Advantest Corp. (Japan); Mark A. Sheppard, Advantest America, Inc. (USA); Toshimichi Iwai, Advantest Corp. (Japan) |
| | 12750-37 • **Evaluating the role of photoacid generator loadings on EUV film homogeneity and byproduct production,** Jander Cruz, Michael Shaw, California State Univ., Northridge (USA); Emile Schweikert, Stanislav V. Verkhoturov, Texas A&M Univ. (USA); Michael J. Eller, California State Univ., Northridge (USA) | 12751-46 • **EUV actinic scatterometry for in-pattern phase metrology,** Stuart Sherwin, Matt Hettermann, Dave Houser, Chami Perera, EUV Technology (USA); Patrick Naulleau, EUV Technology (USA), The Ctr. for X-Ray Optics, Lawrence Berkeley National Lab. (USA) |
| | 12750-38 • **Analysis of dissolution modes of partially protected poly(4-hydroxystyrene) in tetraalkylammonium hydroxide aqueous solutions using decision trees and support vector machine,** Hitomi Betsumiya, Yuqing Jin, Yuko T. Ito, Takahiro Kozawa, SANKEN, Osaka Univ. (Japan); Kazuo Sakamoto, Makoto Muramatsu, Tokyo Electron Kyushu Ltd. (Japan) | 12751-47 • **Innovative applications: extending photomask registration tool for critical dimension measurement to achieve high efficiency,** Yifei Yu, KLA China (China); Vic Chang, Phil Cha, Robert Tsai, Tim Zhong, Jerry Wei, Lynne Yuan, Eric Bi, Quanyi Mask Optoelectronics Technology (Jinan) Co., Ltd. (China); Le Wang, Jinghua Zeng, Wei Chen, KLA China (China) |
| | 12750-39 • **Role of resist components in electron emission and capture,** Oleg Kostko, Terry R. McAfee, Patrick P. Naulleau, Lawrence Berkeley National Lab. (USA) | |
| **EXHIBITION HALL, STEINBECK 1** | Coffee Break • 3:20 PM - 4:00 PM | |
| 4:00 PM -<br>5:30 PM<br>**LOCATION: MONTEREY CONF. CTR., STEINBECK 3** | **All-Symposium Panel: How low can k1 go in EUV lithography?**<br>MODERATORS: **Patrick Naulleau,** The Ctr. for X-Ray Optics (USA); **Seong-Sue Kim,** Seoul National Univ. (Republic of Korea)<br>PANELISTS: **Anton DeVilliers,** TEL (Japan); Chan Hwang, Samsung (Republic of Korea); **Claire van Lare,** ASML (Netherlands); **Kurt Ronse,** IMEC (Belgium); **Marie Krysak,** Intel Corporation (USA) | |
| | **SPIE Photomask Technology + EUV Lithography Awards** | |

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| TIME | CONFERENCE 12750<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 3<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12750<br>**International Conference on Extreme Ultraviolet Lithography 2023** | CONFERENCE 12751<br>LOCATION: MONTEREY CONF. CTR., STEINBECK 2<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12751<br>**Photomask Technology 2023** |
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| **THURSDAY 5 OCTOBER** | | |
| MORNING<br>8:20 AM - 9:45 AM | **SESSION 8** • 8:20 AM - 9:45 AM<br>**EUV Pellicle**<br>Session Chairs: **Herman H. P. Th. Bekman,** TNO (Netherlands); **Kurt G. Ronse,** imec (Belgium) | **SESSION 10** • 8:20 AM - 9:45 AM<br>**Mask Design and Corrections**<br>Session Chairs: **Seung-Hune Yang,** SAMSUNG Electronics Co., Ltd. (Republic of Korea); **Jed H. Rankin,** IBM Corp. (USA) |
| | 12750-40 • INVITED PAPER<br>**Development and performance of high-power EUV pellicles for HVM,** Prashant Purwar, Donghoi Kim, Munsu Choi, Chulkyun Park, Byounghoon Seung, Yongdae Kim, Cheol Shin, Juhee Hong, S&S Tech Co. Ltd. (Republic of Korea) | 12751-48 • INVITED PAPER<br>**Curvilinear OPC mask synthesis flow,** Yunqiang Zhang, Linghui Wu, Jian Yao, Yongdong Wang, Synopsys, Inc. (USA) |
| | 12750-41 • INVITED PAPER<br>**Molybdenum carbide pellicle for high-power EUV lithography,** Yongkyung Kim, Korea Electronics Technology Institute (Republic of Korea), Hanyang Univ. (Republic of Korea); Kihun Seong, Jonghyuk Yoon, Korea Electronics Technology Institute (Republic of Korea), Sungkyunkwan Univ. (Republic of Korea); Donggi Lee, Seungchan Moon, Hanyang Univ. (Republic of Korea); Hyun-Mi Kim, Seul-Gi Kim, Korea Electronics Technology Institute (Republic of Korea); Jinho Ahn, Hanyang Univ. (Republic of Korea); Hyeongkeun Kim, Korea Electronics Technology Institute (Republic of Korea) | 12751-49 • INVITED PAPER<br>**Improvements on pattern fidelity at high curvature region of curvilinear mask with a novel method of MPC,** Ai Kaneko, Taigo Fujii, Itaru Ono, Ahmad Syukri Bin Abdollah, Yohei Torigoe, Nippon Control System Corp. (Japan); Mincheol Kim, Sukho Lee, Eokbong Kim, Sanghee Lee, SAMSUNG Electronics Co., Ltd. (Republic of Korea) |
| | 12750-42 • **Latest developments of CNT based pellicles for high-power EUV lithography,** Márcio D. Lima, Takahiro Ueda, Takeshi Kondo, Lintec of America, Inc. (USA); Tetsuo Harada, Univ. of Hyogo (Japan) | 12751-50 • **PEC-aware MPC for CD quality improvement,** Boram Lee, Soeun Shin, Sukho Lee, Eokbong Kim, Mina Kim, Jin Choi, Sanghee Lee, SAMSUNG Electronics Co., Ltd. (Republic of Korea); Yutaro Sato, Ahmad Syukri, Itaru Ono, Yohei Torigoe, Nippon Control System Corp. (Japan) |
| | 12750-43 • **Carbon nanotube membranes for EUV photolithography: a versatile material platform,** Jarkko Etula, Ahmed Soliman, Tuhin Ghosh, Bjorn Mikladal, Emma Salmi, Emile Van Veldhoven, Ilkka Varjos, Taneli Juntunen, Canatu Oy (Finland) | 2751-51 • **Application of SONR for a better OPC model with a EUV curvilinear photomask,** Chih-I Wei, Siemens EDA (Belgium); Rehab K. Ali, Siemens EDA (Egypt); Andrew Burbine, Fan Jiang, Germain Fenger, Siemens EDA (USA); Seulki Kang, Kotaro Maruyama, Yuichiro Yamazaki, TASMIT, Inc. (Japan); Sujan Sarkar, Matteo Beggiato, Youssef Drissi, Werner Gillijns, Christophe Beral, Sandip Halder, Gian Lorusso, Philippe Leray, imec (Belgium) |
| | 12750-44 • **EUV pellicle technology for high volume wafer production,** Yun-Yao Lin, Pei-Hsun Tsai, Kelvin Elphick, Ching-Ho Hsu, Kun-Lung Shieh, Feng Hao Chang, James C. C. Huang, Jerry C. Y. Chen, Vincent C. W. Wen, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) | 12751-52 • **Machine learning assisted effective OPC verification hotspot capture,** Lianghong Yin, Siemens EDA (USA) |
| STEINBECK LOBBY | Coffee Break • 9:45 AM - 10:15 AM | |
| 10:15 AM - 12:00 PM | **SESSION 9** • 10:15 AM - 12:00 PM<br>**Tools and Processes**<br>Session Chairs: **Kurt G. Ronse,** imec (Belgium); **Eric M. Panning,** Lavorro Inc. (USA) | **SESSION 11** • 10:15 AM - 12:00 PM<br>**Mask Writers**<br>Session Chairs: **Frank E. Abboud,** Intel Corp. (USA); **Jin Choi,** SAMSUNG Electronics Co., Ltd. (Republic of Korea) |
| | 12750-45 • INVITED PAPER<br>**0.33 NA EUV systems for high volume manufacturing,** Stuart Young, Pieter Gunter, Emiel Eussen, Christophe Smeets, Roderik van Es, ASML Netherlands B.V. (Netherlands) | 12751-53 • INVITED PAPER<br>**MBMW-301: paving the way towards the angstrom era of mask writing lithography,** Christoph Spengler, Christof Klein, Hans Loeschner, Elmar Platzgummer, IMS Nanofabrication GmbH (Austria) |
| | 12750-46 • INVITED PAPER<br>**ZEISS AIMS EUV high-NA for actinic mask review for the next EUV scanner generation,** Klaus Gwosch, Renzo Capelli, Matthias Roesch, Robert Nicholls, Bruno Langbehn, Michael Mohn, Andreas Verch, Maximilian Albert, Grizelda Kersteen, Alexander Winkler, Carolin Müller, Sven Krannich, Carl Zeiss SMT GmbH (Germany) | 12751-54 • INVITED PAPER<br>**Multi-beam mask writer MBM-3000 for next generation EUV mask production,** Hiroshi Matsumoto, Jumpei Yasuda, Tomoo Motosugi, Hayato Kimura, Michihiro Kawaguchi, Yoshinori Kojima, Hiroshi Yamashita, Masato Saito, Takao Tamura, Noriaki Nakayamada, NuFlare Technology, Inc. (Japan) |
| | 12750-47 • INVITED PAPER<br>**Status and outlook of EUV optics at ZEISS,** Jörg Zimmermann, Jens Timo Neumann, Dirk Jürgens, Paul Gräupner, Carl Zeiss SMT GmbH (Germany) | 12751-55 • INVITED PAPER<br>**A core engine to enable high quality multibeam mask writers for 2nm node and beyond,** Peter Chang, Harry Ku, M. D. Cheng, Joey Wang, Patrick Lee, Frankie F. G. Tsai, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Jacqueline Atanelov, Anh-Dai Dang, Samuel Kvasnica, IMS Nanofabrication GmbH (Austria) |
| | 12750-48 • **Development of various EUV sources for application in actinic tools for EUV masks,** Donggun Lee, E-SOL, Inc. (Republic of Korea) | 12751-56 • **Development and production deployment of new laser-based mask writer for optical and EUV applications,** Christopher Leavitt, Michael Hunsweck, Florence O. Eschbach, Yang Liu, Kyle T. Vogt, Jun Kim, Andrew T. Sowers, Frank E. Abboud, Intel Corp. (USA); Mikael L. Wahlsten, Robert Eklund, Mats O. Rosling, Peter Henriksson, Anders Svensson, Fredric Ihren, Mycronic AB (Sweden); Youngjin Park, Mycronic Co., Ltd. (Republic of Korea) |

# TECHNICAL CONFERENCE SCHEDULE

| TIME | CONFERENCE 12750<br>LOCATION: MONTEREY CONV. CTR., STEINBECK 3<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12750<br>**International Conference on Extreme Ultraviolet Lithography 2023** | CONFERENCE 12751<br>LOCATION: MONTEREY CONF. CTR., STEINBECK 2<br>Monday–Thursday 2–5 October 2023<br>Proceedings of SPIE Vol. 12751<br>**Photomask Technology 2023** |
|---|---|---|
| 10:15 AM - 12:00 PM | 12750-49 • **Track integrated backside cleaning towards high-NA EUV: Correlation of backside contamination with frontside patterning performance,** Jelle Vandereyken, Vincent Truffert, Sandip Halder, imec (Belgium); Elke Caron, Wesley Zanders, Andreia Santos, SCREEN SPE Germany GmbH (Germany); Masahiko Harumoto, SCREEN Semiconductor Solutions Co., Ltd. (Japan) | 12751-57 • **Ultimate resolution challenge for high-precision EUV mask by using MBMW technology,** Shingo Yoshikawa, Tsukasa Abe, Yukihito Fujimura, Mei Ebisawa, Izumi Hotei, Issei Sakai, Masataka Yamaji, Yasutaka Morikawa, Tatsuya Tomita, Koji Ichimura, Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan) |
| | 12750-50 • **EUV single exposure tip-to-tip variability control through PEB process optimization in BEOL layers,** Syamashree Roy, imec (Belgium); Elke Caron, Andreia Santos, SCREEN SPE Germany GmbH (Germany); Joern-Holger Franke, Paulina A. Rincon-Delgadillo, Jelle Vandereyken, Sandip Halder, imec (Belgium) | 12751-58 • **Integration of e-beam mask writer corrections in MPC applications,** Ingo Bork, Siemens Digital Industries Software, Inc. (USA); Rachit Sharma, Malavika Sharma, Bhardwaj S. Durvasula, Kushlendra Mishra, Siemens Digital Industries Software, Inc. (India); Mary Zuo, Siemens Digital Industries Software, Inc. (USA) |
| | **CLOSING REMARKS** • 12:00 PM - 12:10 PM | |

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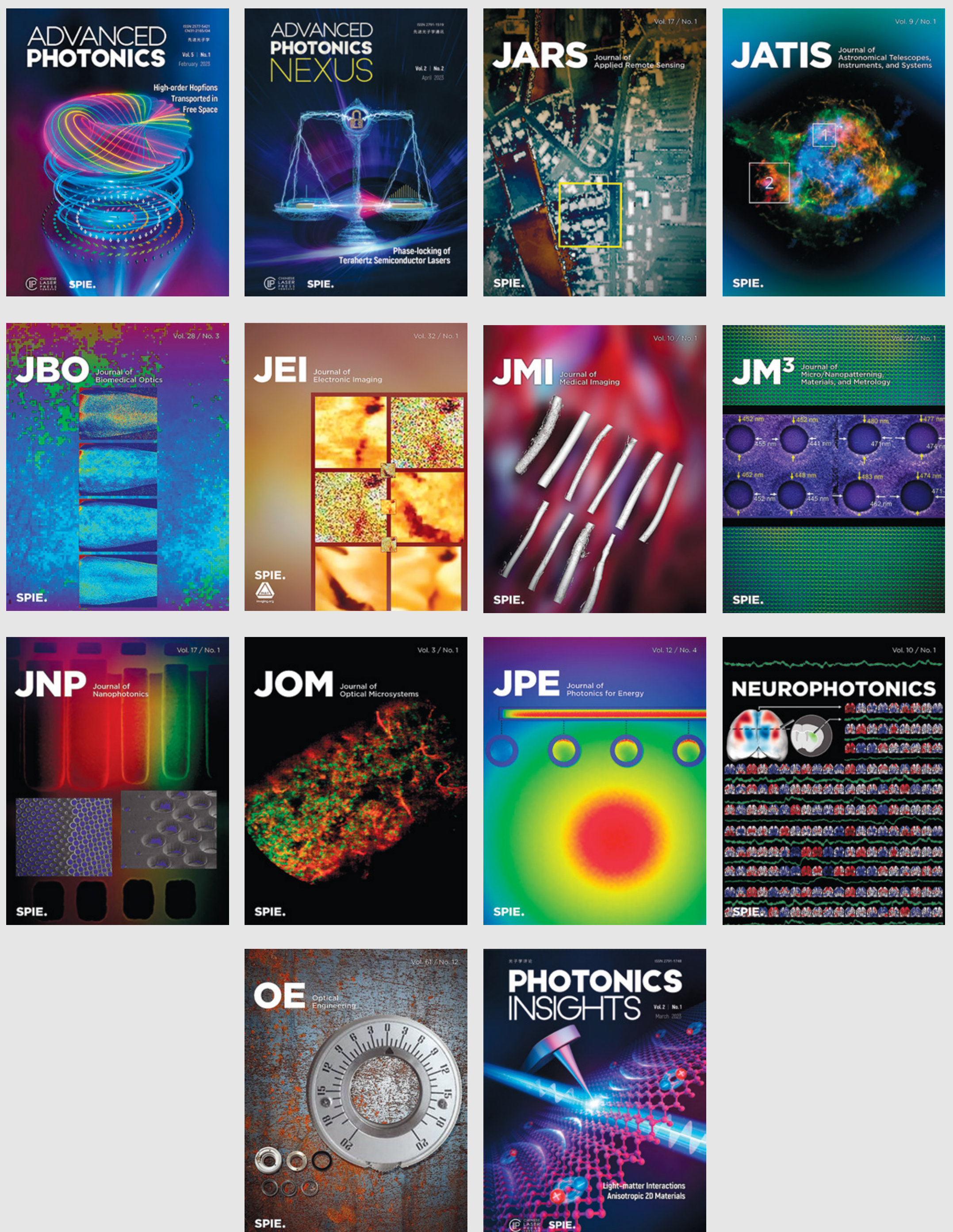


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# Exhibitor Directory

**Monterey Conference Center, Steinbeck 1**

Tuesday 3 October 2023 . . . . . . . . 10:00 AM–4:00 PM
Wednesday 4 October 2023. . . . . . 9:30 AM–4:00 PM

Booth numbers provided in the Exhibition Guide may be cross-referenced with the floor plan below. The address of each exhibitor is also listed, making this Exhibition Guide an excellent reference tool.

| BOOTH # | EXHIBITOR |
|---|---|
| 99 | Semiconductor Digest |
| 101 | attocube systems Inc. |
| 102 | Park Systems Inc. |
| 103 | Stratus Vision GmbH |
| 104 | XYALIS |
| 105 | Energetiq Technology, Inc. |
| 106 | Carl Zeiss SMT GmbH |
| 107 | S&S Tech Co. Ltd. |
| 200 | Mitsui Chemicals America, Inc. |
| 201 | ESTION Technologies GmbH |
| 202 | Gudeng Inc. |
| 203 | ibss Group, Inc. |
| 204 | PLANSEE SE |
| 205 | Heidelberg Instruments Inc. |
| 300 | Andor Technology Ltd. |
| 301 | JENOPTIK Optical Systems, LLC |
| 302 | Nippon Control System Corp. |
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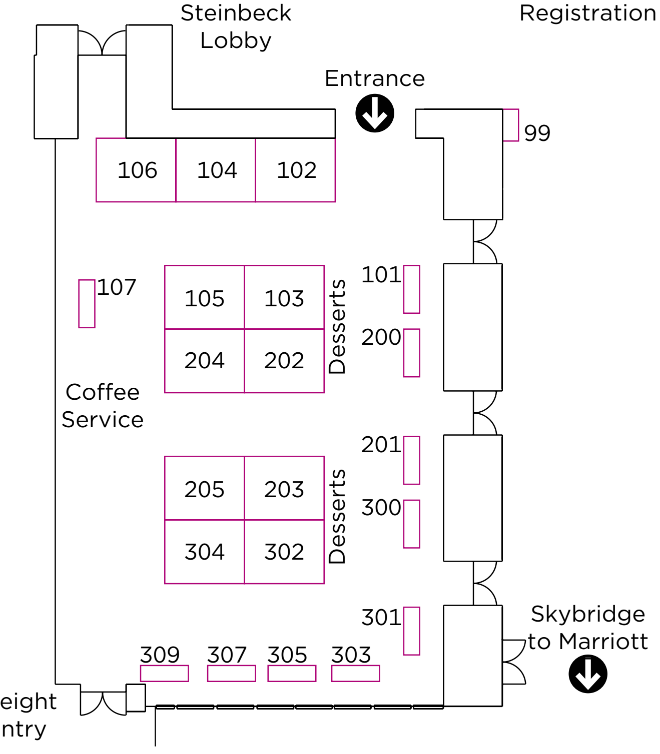
| 304 | Pozzetta, Inc. |
| 305 | MSP Corp. |
| 307 | Lintec of America Inc. |



## Andor Technology Ltd. #300

Springvale Business Park, 7 Millennium Way, Belfast, BT12 7AL United Kingdom
+44 28 9023 7126; fax +44 28 9031 0792
marketing@andor.com; www.andor.com

**Featured Product: Andor offers Marana-X for Soft X-Ray & EUV, iKon CCD for high energy, Kymera modular spectrographs.**

Andor is a global leader in the design and manufacture of high-performance scientific cameras and modular spectroscopy solutions for research and OEM markets. Our CCD and sCMOS cameras are used for direct and indirect detection of X-Ray, EUV, DUV, visible and SWIR wavelengths. Andor's spectroscopy solutions easily integrate into existing or new inspection and metrology platforms, incorporating analytical techniques such as Raman. Visit us to learn how Andor can enable your next market endeavor. Contact: Brad Rangell, Technical Sales Representative - OEM, b.rangell@andor.com; Jouni Jussila, Business Manager - OEM, j.jussila@andor.com

## attocube systems Inc. #101

SPIE. CORPORATE MEMBER

2115 Fourth St Ste B, Berkeley, CA, 94710-2260 United States
+1 510 649 9245
infoUSA@attocube.com; www.attocube.com

attocube offers cutting-edge components for nanoscale applications in research & industry. The business sector 'Cryogenic Instruments' includes nanopositioners, cryostats and microscopes for research in extreme environments, while 'Nanoscale Analytics' develops ultra-fast, high-resolution optical imaging and spectroscopy microscopes. With a strong focus on engineering applications, 'Motion & Sensing' offers high-precision motion and measuring devices for ambient and vacuum conditions. Contact: Patrizia Kellner, Administrative Manager, infoUSA@attocube.com

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## Carl Zeiss SMT GmbH #106

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+49 3641 64 2563; fax +49 3641 64 2938
info.sms@zeiss.com; www.zeiss.com/mask-solutions

ZEISS solutions empower Mask Manufacturers to produce high-end photomasks within given timeframes and budgets.Our dedicated solutions in the fields of photomask repair, qualification, metrology and tuning enable mask makers to meet the tightest specifications for DUV and EUV masks. Contact: Nadine Schütze, Marketing Manager, nadine.schuetze@zeiss.com

## Energetiq Technology, Inc. #105

SPIE. CORPORATE MEMBER

205 Lowell St Ste 1A, Wilmington, MA, 01887-2972 United States
+1 781 939 0763; fax +1 781 939 0769
info@energetiq.com; https://www.energetiq.com

Energetiq Technology, Inc. is an ultra-bright light source subsidiary of Hamamatsu Photonics. Energetiq introduces breakthrough products using our patented, ultra-bright Laser-Driven Light Source (LDLS®) and Electrodeless Z-Pinch® EUV technologies. Our sources are used in a variety of markets, primarily in semiconductor manufacturing, sensor testing for mobile devices, academic research, a variety of life science and medical applications and more. Contact: Mae Steinberg, Marketing Manager, msteinberg@energetiq.com; Bianca Phelps, Marketing Communications Specialist, bphelps@energetiq.com

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## ESTION Technologies GmbH #201

Im Duerren Kopf 38, Griesheim, 64347 Germany
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contact@estion-tech.com; www.estion-tech.com

ESTION has more than 35 years of experience in electrostatic analyzing and problem solving in various industries concentrating on ESD, EOS, EFM and ESA related problems. Main focus is on cleanrooms, wafer front-end manufacturing, photomask and flat-panel manufacturing and handling (transmission and EUV), packaging and assembly. We develop, manufacture and sell in-situ electrostatic test equipment mainly for the electronic industry. We offer training as well as certifying/optimizing of cleanrooms Contact: Thomas Sebald, President, thomas.sebald@estion-tech.com; Heike Mueller, Dir. Customer Care and Administration, heike.mueller@estion-tech.com

## Gudeng Inc. #202

SALES DEPT., 4300 N. Miller Road, Suite 110-10, Scottsdale AZ 85251, United States
+1 408 966 4419
sales@gudengus.com; www.gudeng.com.tw

**Featured Product: EUV reticle POD, RSP 150, RSP 200, Reticle Shipping Box, and 4~18′ Wafer carriers**

Gudeng offers a wide range of total solutions to our customers and business partners. Our products include EUV reticle POD, RSP 150, RSP 200, Reticle Shipping Box, and 4~18" Wafer carriers. We also provide services to customers such as carrier cleaning and contamination tests. Gudeng also offers on-site services at customer's production sites to help customer clean carriers and provide after-sales services for equipment. For more information, please visit our website at https://www.gudeng.com/ Contact: Patty Wong, Account Manager, patty.wong@gudengus.com; Ellen Wu, Manager, ellen.wu@gudeng.com

## Heidelberg Instruments Inc. #205

SPIE. CORPORATE MEMBER

2539 W 237th St Ste A, Torrance, CA, 90505-5239 United States
+1 310 212 5071; fax +1 310 212 5254
sales@heidelberg-instruments.com;
https://heidelberg-instruments.com/

## HORIBA Instruments Inc. #303

430 Indio Way, Sunnyvale, CA, 94085-4202 United States
+1 408 730 4772; fax +1 408 730 8975
rosana.ramirez@horiba.com;
www.horiba.com/int/semiconductor

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HORIBA is a global group of companies that provides analytical and measurement equipment in Semiconductor and other industries. We are a global leader in process metrology and control and we are expanding our business operations by leveraging our advanced technological capabilities and global network. Our Semiconductor product offering ranges from gas and liquid flow components to particle detectors for CMP and complex concentration monitoring equipment. Contact: Rosana Ramirez, Marketing Manager, rosana.ramirez@horiba.com; Terra Gifft, Marketing Specialist, terra.gifft@horiba.com

## ibss Group, Inc. #203

SPIE. CORPORATE MEMBER

111 Anza Blvd Ste 110, Burlingame, CA, 94010 United States
+1 650 513 1488; fax +1 650 513 1884
admin@ibssgroup.com; https://www.ibssgroup.com

# EXHIBITOR LISTING

## JENOPTIK Optical Systems, LLC #301

SPIE. CORPORATE MEMBER

16490 Innovation Dr, Jupiter, FL, 33478-6449 United States
+1 561 881 7400; fax +1 561 881 1947
sales@jenoptik-inc.com; www.jenoptik.us

Jenoptik Optical Systems is a globally operating photonics technology group which is present in more than 80 countries. Optical technologies are the very basis of our business. We design and build high-performance optical and micro optical lenses and systems leading semiconductor manufacturing equipment, medical diagnostic instruments, security and projection systems as well as internet communications technology. We are ISO 9001 and ISO 13485 certified as well as ITAR compliant. Contact: Ray Malcom, Sales Director, ray.malcom@jenoptik.com

## Lintec of America Inc. #307

2900 E Plano Pkwy, Plano, TX, 75074-7475 United States
+1 214 812 9492; fax +1 214 812 9492
lintec-usa.com

## Mitsui Chemicals America, Inc. #200

101 Metro Dr, San Jose, CA, 95110-1314 United States
+1 408 453 0682; fax +1 408 453 0684
m.silverthorne@mitsuichem.com; us.mitsuichemicals.com

## MSP Corp. #305

5910 Rice Creek Pkwy Ste 300, Shoreview, MN, 55126-5025 United States
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sales@mspcorp.com; www.tsi.com/msp

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## Nippon Control System Corp. #302

US Branch, 2880 Zanker Rd Ste 203, San Jose, CA, 95134-2122 United States
+1 408 737 0338; fax +1 408 737 0329
mdp-team@nippon-control-system.co.jp; https://www.nippon-control-system.co.jp/en/index.html

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## Park Systems Inc. #102

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+1 408 986 1110; fax +1 408 986 1199
info@parksystems.com; www.parksystems.com/

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## Pozzetta, Inc. #304

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+1 303 783 3172; fax +1 303 374 7342
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**Featured Product: Secure Environments for Semiconductor Materials**

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## S&S Tech Co. Ltd. #107

42 Hosandong-Ro, Dalseo-Gu, 42714 Korea, Republic of
+82 53 589 1655; fax +82 53 585 7170
sales@snstech.co.kr; snstech.co.kr

**Featured Product: EUV Blank mask, EUV Pellicle, DUV Phase Shift Masks, DUV Flat Panel Displays**

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## Semiconductor Digest #99

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kerryh@semiconductordigest.com; www.semiconductordigest.com

**Featured Product: Semiconductor Industry News and Trends**

Through a mix of news, contributed articles and staff-written articles, Semiconductor Digest is dedicated to providing information about the design, manufacturing, packaging and testing of semiconductors and other types of electronic devices, including MEMs, LEDs, displays, power electronics, opto-electronics/photonics, biomedical devices, solar cells, thin film batteries and flexible electronics. With global coverage, Semiconductor Digest consists of a website, a magazine, and newsletters. Contact: Kerry Hoffman, Publisher, kerryh@semiconductordigest.com; Pete Singer, Editor-in-Chief, psinger@semiconductordigest.com

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## Stratus Vision GmbH #103

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+49 89 413 293 201
sales@stratusvision.com; www.stratusvision.com

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## XYALIS #104

5 Place Robert Schuman, Grenoble, 38000 France
+33 4 56 58 36 34; fax +33 476 282 849
info@xyalis.com; www.xyalis.com

**Featured Product: New MPW design flow minimizing die fracture in advanced 3D packaging wafer thinning process.**

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Heraeus Quartz North America LLC
HighRI Optics, Inc.
Hinalea Imaging
Hind High Vacuum Co. Pvt. Ltd.
Hinds Instruments, Inc.
Hitachi High-Tech America, Inc.
HIWIN Corp.
Hofstadter Analytical Services, LLC
HOLO/OR Ltd.
HOLOEYE Photonics AG
Holographix LLC
HORIBA Scientific
HOYA Corp. USA
HUBNER Photonics
Hyperion Optics USA Inc.
HySpex
Ibsen Photonics A/S
ibss Group, Inc.
IDEX Health & Science, LLC
II-VI Aerospace & Defense, Inc.
ilis gmbh
Imagine Optic SA
imec
IMPERX, Inc.
IMRA America, Inc.
Incom, Inc.
Industrial Laser Machines, LLC
Infinite Optics Inc.
Infrared Materials, Inc.
InfraTec Infrared LLC
INGENERIC GmbH
Innolite GmbH
Innovations in Optics, Inc.
Innovative Photonic Solutions
INO
Inrad Optics
International Defense & Security Solutions, Inc.
InterOptics, LLC
Intlvac Thin Film
Intpho (Fujian) Technology Co., Ltd.
IO Industries, Inc.
IPG Photonics Corp.
I-Photonics UAB
Iradion Laser, Inc.
IRD Glass
IRflex Corporation
Irish Photonic Integration Ctr. (IPIC)
Irisiome Solutions
IRnova AB
ISS, Inc.
Isuzu Glass, Inc.
ITF Technologies Inc.
J.A. Woollam Co., Inc.
Janos Technology, LLC
JAYCO Cleaning Technologies
JenLab GmbH
JENOPTIK Optical Systems GmbH
JENOPTIK Optical Systems, LLC
JEOL USA Inc.
Jilin Yongli Laser Technology Co., Ltd.
JSR Micro, Inc.
Kaufman & Robinson, Inc.
Kentek Corp.
Kern Technologies, LLC
KostaCLOUD Inc.
KrellTech
KT Photonics Inc.
L3Harris Technologies Inc., Kigre
Labsphere, Inc.
LaCroix Precision Optics
Lambda Research Corp.
Lambda Research Optics, Inc.
LambdaMetrics LLC
Laser Components USA, Inc.
Laser Focus World
Laserline Inc.
LaserPlus LLC
Laservision USA
LASOS Lasertechnik GmbH
Le Verre Fluoré
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MKS Instruments, Inc.
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MPS Micro Precision Systems AG
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Nanomotion Inc.
nanoplus America Inc.
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# Moving technology to market—together.



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Navitar Inc.
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New Imaging Technologies
New Scale Technologies, Inc.
New Source Technology, LLC
New York Photonics
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NextCorps
NIL Technology ApS
Nivo Technology
NKT Photonics A/S
NKT Photonics Inc.
NLM Photonics
NoIR InSight
NorPix, Inc.
North American Coating Labs.
Northrop Grumman Cutting Edge Optronics
Novanta, Inc.
Novotech, Inc.
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NTFL
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NUVIEW, Inc.
Nüvü Cameras Inc.
NYFORS
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Ocean Optics
OEwaves, Inc.
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OFS Fitel, LLC
Ohara Corp.
Omega Optical Holdings, LLC
Omega Optics, Inc.
Omicron Laserage Laserprodukte GmbH
Oorym Optics Ltd.
Optec S.p.A.
Optical Engines, Inc.
Optical Filter Source, LLC
Optical Support, Inc.
Opticho Inc., Ltd.
Optics Technology, Inc.
Optics Valley
Optiforms, Inc.
OptiGrate – IPG Photonics
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Optikron GmbH
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OptiPro Systems, LLC
OptiPulse, Inc.
Optiwave Systems Inc.
Opto-Alignment Technology, Inc.
Optogama UAB
Opto-Line International, Inc.
OPTOMAN
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Optonique
Optoprofiler LLC
OptoSigma Corp.
OptoSigma Europe S.A.S.
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OptoTech Optikmaschinen GmbH
Optotune Switzerland AG
OSELA Inc.
Oxxius SA
OZ Optics Ltd.
Pacific Laser Equipment
Pacific Lasertec, LLC
Palomar Technologies, Inc.
Pantec Biosolutions AG
Pavilion Integration Corp.
Pecchioli Research Srl
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PFG Precision Optics, Inc.
Phaseform GmbH
PHASICS Corp.
PHASICS S.A.
PHIX Photonics Assembly
Photon Design
Photon Engineering LLC
Photon Etc. Inc
Photon Force Ltd.
PHOTON LINES Ltd.
Photonic Cleaning Technologies
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Photonics Industries International, Inc.
Photonics Industry & Technology Development Association
Photonics Media/Laurin Publishing
Photonics Technologies Ltd.
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Photonis Scientific, Inc.
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PI (Physik Instrumente) L.P.
PI (Physik Instrumente) UK Ltd.
PicoQuant Photonics North America, Inc.
PIEZOCONCEPT
PIKE Technologies
Pixelligent Technologies LLC
Planar JSC
PlaneWave Instruments, Inc.
PLC Industries Pte Ltd.
Polaris Motion
poLight AS
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PowerPhotonic Inc.
PowerPhotonic Ltd.
Precision Glass & Optics
Precision Laser Scanning
Precision Optical
Princeton Infrared Technologies, Inc.
Princeton Scientific Corp.
Prior Scientific Inc.
Prior Scientific Instruments Ltd.
Prizmatix Ltd.
Prospective Instruments LK OG
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Pureon Inc.
PWY Service GmbH & Co. KG
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QED-C
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QPC Lasers Inc.
Qual Diamond Hi-Tech
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QuantIC
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RedWave Labs Ltd.
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Rigaku Innovative Technologies, Inc.
Riverhawk Co.
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Rocky Mountain Instrument Co.
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Ruda Optical
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Sacher Lasertechnik GmbH
Safran Optics 1
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Satisloh North America Inc.
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ScannerMAX
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Schneider Optics, Inc.
SCHOTT AG
SCHOTT North America, Inc.
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SCI Engineered Materials
scia Systems GmbH
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Sensir Inc.
Sensors Unlimited, a Collins Aerospace Co.
SEQENS
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Sheaumann Laser, Inc.
Shimifrez Inc.
Shin-Etsu MicroSi, Inc.
Sierra Precision Optics
Sierra-Olympia Technologies, Inc.
SILIOS Technologies
Siskiyou Corporation
Si-Ware Systems
SmarAct Inc.
Somos IWT
son-x GmbH
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Spectral Instruments, Inc.
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Spectrogon UK Ltd.
Spectrogon US, Inc.
Spectrolight Inc.
Spectrum Scientific, Inc.
Spica Technologies, Inc.
SPO Precision Optics
SRI International
Stensborg A/S
Sunny Technology
Superlum Diodes Ltd.
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Swabian Instruments GmbH
Swabian Instruments USA Inc.
SWIR Vision Systems
Sydor Optics, Inc.
Synopsys, Inc.
Syntec Optics
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TecOptics Corp.
Tecport Optics, Inc.
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Teledyne Acton Optics
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Teledyne e2v UK Ltd.
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Teledyne Imaging
Teledyne Imaging Sensors
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Teledyne Photometrics
Teledyne Princeton Instruments
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Thorlabs Ltd.
Thorlabs, Inc.
Tian Optics
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Corporate Member list as of June 2023

# SPIE EVENT POLICIES

## Acceptance of policies and registration conditions

The following policies and conditions apply to all SPIE events, both online and in person. As a condition of registration, you will be required to acknowledge and accept the SPIE policies and conditions contained herein.

SPIE has established a confidential reporting system for all SPIE event participants to raise concerns about possible unethical or inappropriate behavior within our community. When at an SPIE event, you may contact any SPIE staff with concerns. If you feel that you are in immediate danger, please dial the local emergency number for police intervention.

### Agreement to hold harmless

Attendee agrees to release and hold harmless SPIE from any and all claims, demands, and causes of action arising out of or relating to your participation in the event you are registering to participate in and use of any associated facilities or hotels.

### Be well agreement

Any public space where other people are present holds an inherent risk of exposure to COVID-19 and other communicable diseases. By attending this event, I agree to voluntarily assume all risk related to exposure and agree to not hold SPIE or any of their affiliates including partners and sponsors, directors, officers, employees, agents, contractors, volunteers, or sponsored venues liable for illness. I will take necessary precautions while at the event including, but not limited to, engaging in appropriate social distancing, wearing a mask in public areas when not consuming food or beverage if required, minimizing face touching, frequently washing hands, and avoiding risky environments such as overcrowded bars or restaurants. I agree to not attend any SPIE event if I feel ill or had recent exposure to a COVID-19 case.

### Anti-harassment policy

It is SPIE policy that all employees, volunteers, and participants are entitled to respectful treatment. Any form of bullying, discrimination, harassment, sexual or otherwise, is unacceptable and will not be tolerated. This policy applies to all locations and situations where SPIE business is conducted and to all SPIE-sponsored activities and events.

*Read complete policy: spie.org/policies*

### Attendee registration and admission policies

SPIE, or their officially designated event management, in their sole discretion, reserves the right to accept or decline an individual's registration for an event. Further, SPIE, or event management, reserves the right to prohibit entry of or to remove any individual whether registered or not, be they attendees, exhibitors, representatives, or vendors, whose conduct is not in keeping with the character and purpose of the event. Without limiting the foregoing, SPIE and event management reserve the right to remove or refuse entry to anyone who has registered or gained access under false pretenses, provided false information, or for any other reason whatsoever that they deem is cause under the circumstances.

### Capture and use of a person's image

By registering for an SPIE event, you grant full permission to SPIE to capture, store, use, and/or reproduce your image or likeness, including incidental capture of any individuals in your household or workplace, by any audio and/or visual recording technique and create derivative works of these images and recordings in any SPIE media now known or later developed, for any legitimate SPIE purpose. By registering for an SPIE event, you waive any right to inspect or approve the use of the images or recordings or of any written copy. You also waive any right to royalties or other compensation arising from or related to the use of the images, recordings, or materials. By registering, you release, defend, indemnify, and hold harmless SPIE from and against any claims, damages, or liability arising from or related to the use of the images, recordings or materials, including but not limited to claims of defamation, invasion of privacy, or rights of publicity or copyright infringement, or any misuse, distortion, blurring, alteration, optical illusion, or use in composite form that may occur or be produced in taking, processing, reduction, or production of the finished product, its publication or distribution.

### Code of conduct

SPIE is committed to providing a harassment- and discrimination-free experience for everyone at our events, an experience that embraces the richness of diversity where participants may exchange ideas, learn, network, and socialize in the company of colleagues in an environment of mutual respect.

*Read complete Code of Conduct: spie.org/policies*

### Event cancellation policy

If for some unforeseen reason SPIE should have to cancel an event, processed registration fees will be refunded to registrants. Registrants will be responsible for cancellation of travel arrangements or housing reservations and the applicable fees.

### Family-friendly policy

**Conference events:** All conference technical and networking events require a badge for admission. Registered attendees may bring children with them if they have been issued a badge. Registration badges for children under 18 are free and available at the SPIE registration desk onsite. Children under 14 years of age must be accompanied by an adult at all times, and guardians are asked to help maintain a professional, disturbance-free conference environment.

**Exhibition hall:** Everyone who attends the exhibition must be registered and have a badge. Badges for children are free and available onsite at the registration desk. Children under 14 years of age must be accompanied by an adult at all times. Guardians are asked to help maintain a professional, disturbance-free exhibition environment. Children under 18 are not allowed in the exhibition area during exhibition move-in and move-out.

### Identification requirement

To verify registered participants and provide a measure of security, SPIE will ask attendees to present a government-issued photo identification at registration to collect registration materials. Individuals are not allowed to pick up badges for other attendees. Further, attendees may not have some other person participate in their place at any conference-related activity. Such other individuals will be required to register on their own behalf to participate.

For online events, SPIE requires individuals to register with their legal identity.

### Laser-pointer safety policy

SPIE events are subject to the applicable laser safety rules and regulations of the host location. SPIE supplies industry standard Class 2 presentation laser pointers for all conference and other meeting rooms. For safety reasons, SPIE requests that presenters use provided laser pointers. Use of a personal laser pointer represents the user's acceptance of liability for any damage or injuries to presenter or others.

### No smoking policy

Attendees will observe all non-smoking regulations that are publicly posted by the facilities used by the event.

### Payment policy

Registrations must be fully paid before access to the conference is allowed. SPIE accepts VISA, MasterCard, American Express, Discover, Diner's Club, checks, and wire transfers. Onsite registrations can also be paid with cash.

### Recording policy

**Conferences, courses, and poster sessions:** For copyright reasons, recordings of any kind are prohibited without prior written consent of the presenter or instructor. Attendees may not capture or use materials presented in any meeting/course room or in course notes on display without written permission. Consent forms are available at speaker check-in, SPIE registration, or from SPIE online event hosts. Individuals not complying with this policy will be asked to leave a given session and/or asked to surrender their recording media. Refusal to comply with such requests is grounds for expulsion from the event.

**Exhibition hall:** Recordings of any kind are prohibited without explicit permission from on-site company representatives. Individuals not complying with this policy will be asked to surrender their recording media and to leave the exhibition hall. Refusal to comply with such requests is grounds for expulsion from the event.

### Unauthorized solicitation

Unauthorized solicitation in the exhibition hall is prohibited. Any non-exhibiting organization observed to be distributing information or soliciting business in the aisles, or in another company's booth, will be asked to leave immediately.

### Unsecured items

Personal belongings should not be left unattended in meeting rooms or public areas. Unattended items are subject to removal by security. SPIE is not responsible for items left unattended.

### Wireless internet service

At most events, SPIE provides wireless access for attendees. Properly secure your computer before accessing the public wireless network. SPIE is not responsible for computer viruses or other kinds of computer damage.

**SPIE International Headquarters:** PO Box 10, Bellingham, WA 98227-0010 USA • Tel: +1 360 676 3290 • help@spie.org • www.SPIE.org

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# NOTES

SPIE.

SPIE, the international society for optics and photonics, brings engineers, scientists, students, and business professionals together to advance light-based science and technology. The Society, founded in 1955, connects and engages with our global constituency through industry-leading conferences and exhibitions; publications of conference proceedings, books, and journals in the SPIE Digital Library; and career-building opportunities. Over the past five years, SPIE has contributed more than $22 million to the international optics community through our advocacy and support, including scholarships, educational resources, travel grants, endowed gifts, and public-policy development.

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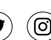

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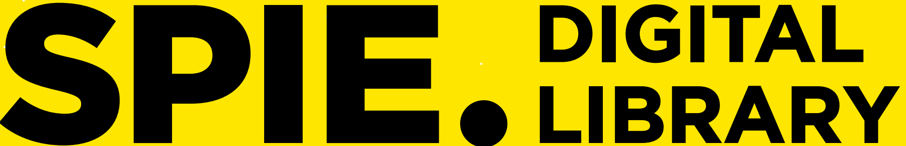


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